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ARCHEOLOGY.—*Palachacolas Town, Hampton County, South Carolina.*[1]

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The importance of the archeological site Palachacolas Town on the lower Savannah River lies in the certainty of its historical dating and ethnological identification. Pending the development of a general method of dating archeological materials in eastern North America,[2] the only absolute chronology available is for localities known to have been occupied by specific groups of Indians in historic times. Archeological materials and artifacts from sites which were not reoccupied or inhabited prior to the documented dating can be presumed to have been in use during the period of the recorded dates. Conversely, such artifacts can then help date other undocumented sites at which they may be found.

Palachacolas Town, later called Parachocolas Fort or simply Parachuckle, was situated on the right bank of the Savannah River about 50 miles from the mouth. The site had been occupied sometime during 1680–1716 A.D. by a band of Appalachicola Indians, who were Lower Creeks speaking the Hitchiti dialect.

The Creek Migration legend places these people in southwestern Georgia when they were first encountered by the invading Muscogee, and Swanton has pointed out that they later composed an important town in the Creek Confederacy[3]:

> . . . shown by the Creek name which it bears, Talwa lako, "Big Town," and from Bartram's statement that it was the leading White or Peace town . . . in Chiaha Square, September 18, 1768, a Lower Creek speaker says: There are four head men of us who have signed our names in the presence of the whole lower Creeks as you will see: Two of us out of Pallachicolas which is reckoned the head town of the upper and lower Creeks. . . .

The Appalachicola remained in southwest Georgia at least until 1680[4] but Milling has marshalled data to show that they arrived on the Savannah River no later than 1684.[5] Certain it is that these people were located on the Savannah River for some time prior to 1716 and abandoned the town in that year, after the Yamassee War. According to Swanton:

> . . . the Apalachicola, and part of the Yuchi and Shawnee, abandoned their settlements on the Savannah and moved over to the Chattahoochee. The Apalachicola chief at that time was named Cherokee Leechee (Cherokee killer). The date is fixed by a manuscript map preserved in South Carolina. They settled first at the junction of the Flint and Chattahoochee Rivers, at a place known long afterwards as Apalachicola Fort. Later they abandoned this site and went higher up; in fact, they probably moved several times.[6]

Evidence to substantiate a dating between 1680 and 1716 is found at the Palachacolas site itself, for the fragments of Indian clay pottery there closely resemble potsherd material from the historic (Hitchiti) Trading Post, at Ocmulgee near Macon, Ga., dated 1680–1718, and resemble sherds from the Kasita site, near Columbus, Ga., late seventeenth to early eighteenth centuries.[7]

[1] Received August 16, 1948. This paper is published by permission of the Secretary, Smithsonian Institution. The bulk of the material described is in the United States National Museum.

[2] See MARTIN, QUIMBY, and COLLIER, 1947, pp. 9–13, for a recent summary of methods of archeological dating. Also Kelly, 1939.

[3] SWANTON, 1922, p. 129.

[4] *Ibid.*, p. 130.

[5] MILLING, 1940, pp. 176–177.

[6] SWANTON, 1922, p. 131.

[7] KELLY, 1939, p. 332. See also Newsletter, Southeastern Archaeological Conference, pottery

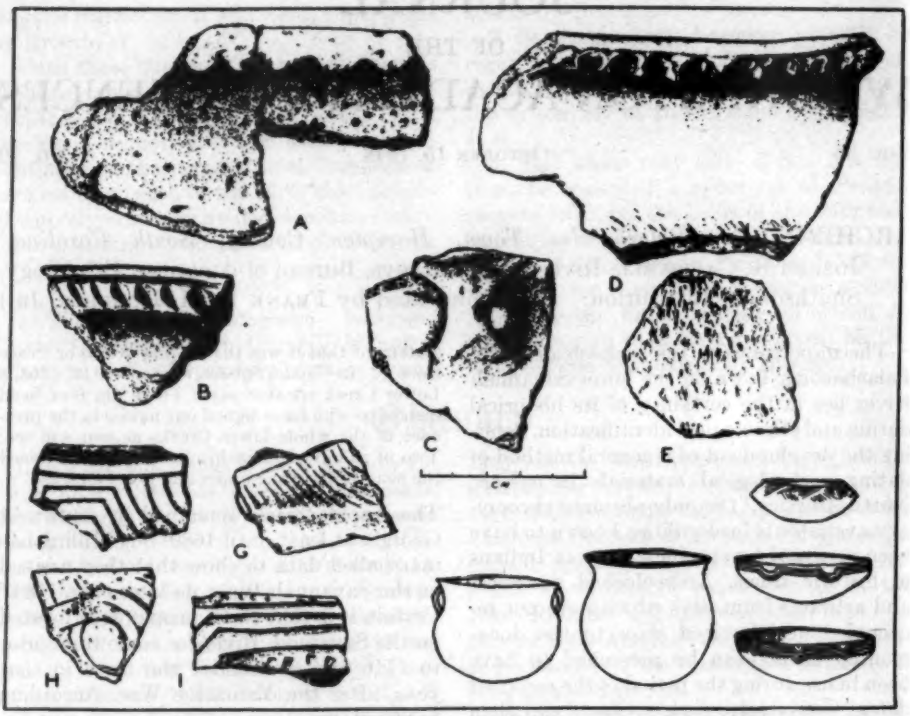

FIG. 1.—Historic Indian pottery from Palachacolas ca. 1680–1716 A.D.

In 1901 D. Roland Steiner sent two small pottery vessels and some glass beads from Palachacolas to the United States National Museum. We do not, unfortunately, know the circumstances under which this material was found. A much larger collection was received in 1943 through the courtesy of Marmaduke H. Floyd, of Savannah, Ga. A few potsherds were also obtained by the writer when he accompanied Mr. Floyd to the site in 1939.

POTTERY

The larger of the two pottery vessels found by Steiner is shown in Fig 2, A. Both have a similar form which is characteristic of the western Georgia type *Kasita Red Filmed.*[8] They are fired to a reddish color extending through the paste, and the smaller vessel appears as if it might have been painted. This specimen shows no tempering material, but grit particles are present in the larger. Both have their surfaces carelessly smoothed, but the coil fillets on the exterior of the one shown were left partly unobliterated, perhaps for the effect.

The sherds in Fig. 1 are all from the writer's collection, but the description here includes Floyd's ceramic material as well. Altogether there are seven sherds decorated by incising (B, F, G, H, I) conforming closely to the type *Ocmulgee Fields Incised.* Six are from shallow bowls, two with a carinated shoulder. The firing colors range from reddish buff to dark gray. The two dark gray sherds are burnished, and nearly all the rest are carefully smoothed on both surfaces. No tempering material can be seen, but some small lacunae are present.

The 16 plain sherds have the same paste features as those decorated by incising, but

types: *Ocmulgee Fields Incised, Kasita Red Filmed, Walnut Roughened.*

[8] See preceding footnote.

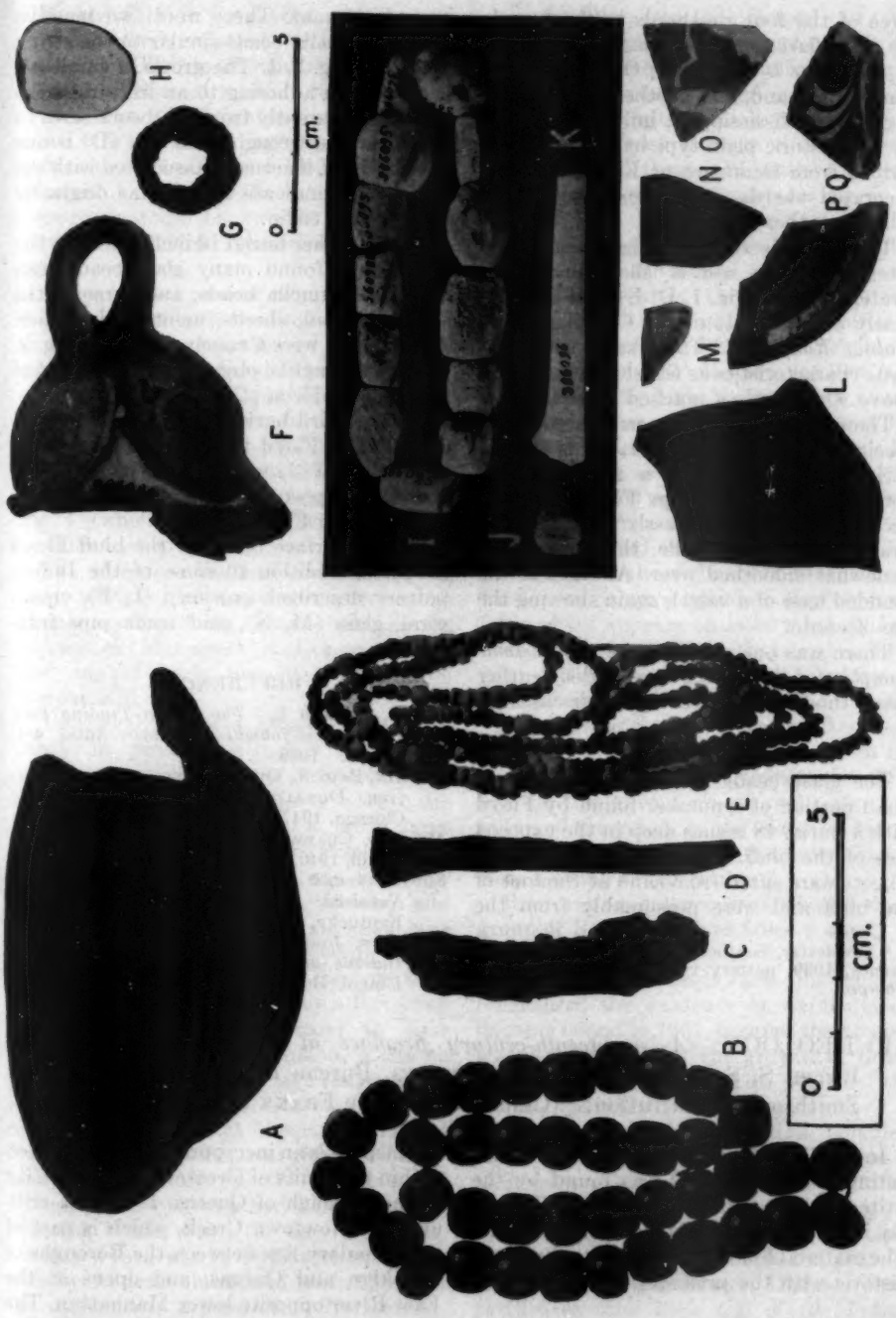

FIG. 2.—Historic artifacts from Palachacolas.

three of the four rimsherds in the sample are from flaring rim vessels, and the form of the other is uncertain. One has an indented rim band, and another has a handle suggesting Mississippian influence (Fig. 1, C). No historic plain type has yet been described from Ocmulgee or Kasita, but undecorated sherds are represented in the collections there.

Three sherds show a roughening of the exterior by the use of short incised or scratched lines (Fig. 1, D, E) and are evidently counterparts of the Ocmulgee type *Walnut Roughened*. They have the same paste characteristics as the sherds described above. One shows a pinched rim band.

There are six shell-tempered sherds. The specimen illustrated (Fig. 1, A) is from a flaring rim vessel with a thickened lip, notched at the lower edge. Four sherds are decorated with a carelessly applied cord-wrapped stick or paddle, the impressions somewhat smoothed over. Another is the rounded base of a vessel, again showing the use of cord.

There was one sherd of the type *Lamar Complicated Stamped*, a type slightly earlier than those we have been discussing.[9]

OTHER ARTIFACTS

The glass beads in Fig. 2, B, E, are a small portion of a number found by Floyd with a burial 18 inches deep in the exposed face of the bluff. Similar beads and other objects were sifted from sand at the foot of the bluff and were presumably from the same interment. There were two massive conch columella beads similar to the string shown in Fig. 2, I. The group of small red beads shown adhering to an iron fragment (C) was apparently from beadwork sewn to clothing. The wrought-iron nail (D) is one of two which, if actually associated with the burial, may indicate that it was originally in a wooden coffin.

With another burial 12 inches deep in the bluff Floyd found many glass beads, two massive columella beads, and three of the shell-tempered sherds mentioned earlier. Also present were a conch shell disc, Fig. 2, H, an iron ringlike object (G), and a part of a copper cauldron (F).

With a third burial which had fallen out of the bluff Floyd found glass beads similar to those shown, as well as the shell beads (I), pipestem (K), and lead bullet (J) illustrated in Fig. 2.

On the surface but near the bluff Floyd found, in addition to some of the Indian pottery described, crockery (L, P), chinaware, glass (M, N), and trade pipe fragments.

[9] Newsletter, Southeastern Archeological Conference, 1939, pottery type *Lamar Complicated Stamped*.

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ARCHEOLOGY.—*A seventeenth-century fireplace at Maspeth, Long Island.*[1]

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In April 1935 an early colonial fireplace dating from circa 1650 was found by the writer and a companion, Stanley Wisniewski, in an open lot at Maspeth, Long Island. The material found in the fireplace links the historic with the prehistoric periods there.

[1] Received August 16, 1948.

Maspeth is an incorporated town situated within the limits of Greater New York City in the Borough of Queens. It is on a tributary of Newtown Creek, which is part of the boundary line between the Boroughs of Brooklyn and Queens, and opens at the East River opposite lower Manhattan. The tributary, Maspeth Creek, was called

"Mespat Kill" in the seventeenth century, and the land adjacent to it was called "English Kills" in recognition of the first English settlement made in this locale.

Newtown Creek today is one of New York City's most important unloading points for sea traffic in coal, oil, and lumber. Maspeth, now only half an hour from Times Square, was the backwoods and outlying settlement of New Netherlands 300 years ago.

Maspeth, the present name of the town, is derived from both the English and Dutch versions of Mespaetches or Maspechtes, which approaches the idiom of the aborigines. The names "Mespat" and "Mispat" appear in seventeenth century writings and maps, and in keeping with this practice we will use the name Mespat. Mispat appears on A. Van der Donck's map of 1656 (see Fig. 1), which apparently had been copied by later cartographers.

The Canarsee Indians, with whom the early settlers had many dealings, were a strong western Long Island tribe of the Metoac or Matouwac confederacy. They had one of their principal villages on Mespat Kill.

Aboriginal artifacts attesting to occupancy in pre-historic times were there prior to the development of Newtown Creek and environs. These artifacts were quite numerous, suggesting that a fairly large Indian village had been there (Bolton, 1922, pp.173–175). The situation was favorable enough, with creeks, hills, forests, and pleasant country. Game of all kinds was plentiful, according to early records.

The first settlement within the bounds of Newtown was made in 1642 by a Reverend Francis Doughty, a newcomer to New Netherlands from New England, where he had experienced difficulty with the founding fathers. He and his associates were granted settlement privileges at Mespat by William Kieft, the Director-General of New Netherland (Riker, 1852, pp. 17–19). Reverend Doughty and his flock had barely time to establish house, when the native Indians, instigated into war in 1643 with the colonists by the gross blunders of Kieft, attacked the settlements around New Netherland, including Mespat. Its inhabitants were forced to flee, and their homes and farms were devastated and ruined. Thus was broken up one of the budding English settlements on Long Island.

Director Kieft made overtures to the Indians and, with the help of several wiser men, placated them. The settlers returned to Mespat, but the settlement never recovered from the shock of warfare.

Mespat was seized with terror again in 1653, during the Dutch and English war (1652–1654), when the English settlers learned that the Dutch were negotiating with the Indians to destroy the English on Long Island. The Mespat settlers once again fled, this time to Stamford, Conn., a strong English settlement. The war ended, and the settlers dribbled back again. Another alarm was made in 1656, when this time the Dutch neighbors of the English at Mespat, in fear of retaliations from the Indians, banded together for safety. They concentrated themselves for mutual protection on Smith's Island at English Kills. This island appears on later maps as Furman's Island, or Maspeth Island (now a part of the mainland, and covered by an aluminum plant).

This new settlement was called Aernheim in honor of the leader's birthplace on the Rhine. The leader was Nicasius De Sille, one of the governor's council, who had obtained the patent to the island on March 27, 1656. By April the diligent villagers were mowing the meadows.

Brief excitement occurred when a small group of Raritan Indians killed a family at Mespat Kill in 1659.

Director Stuyvesant and his council terminated the existence of Aernheim on Smith's Island in 1661, because they feared that it might hinder the growth of Bushwick, which was planted in 1660 by the French and a few Dutch.

There were no further Indian troubles, and the Canarsees settled the last piece of their reservation to the English in 1666 for £66 and some change. A scattering of Indians remained, "some of whom had their wigwams at Mespat Kills" (Riker, 1852, p. 73) for several years later. Disease, wars, pestilences took their toll of the Indian population within the first 50 years of the

MAP OF NEW NETHERLANDS,
With a view of New Amsterdam, (now New-York.) A. D. 1656.
Copied for the N. Y. Hist. Soc. from the Map of A. Vander Donck.

FIG. 1.—Map of New Netherlands, A.D. 1656. From A. Van der Donck, *Description of New Netherlands.*

colonization of New Netherland, as it did everywhere on New England, and Indian survivors into the eighteenth century were few indeed.

THE FIREPLACE

The site of the fireplace was located between what was formerly known as Shanty Man's Creek and Maspeth Creek, or Mespat Kill, on the road to old Aernheim. The present road is called Maspeth Avenue. The fireplace faced the northeast about 30 feet south of Maspeth Avenue in line with Milton Street. When found, the fireplace was covered (Fig. 2, F) except for a corner of yellow brick protruding from the slope, by an eroded sand bank 3 feet deep. The hearth and back and sides of the fireplace were uncovered easily in the sandy soil. It was 3½ feet long and 1½ feet high. A 6-inch layer of wood ashes and black earth was found at the top, lying over a carefully laid arrangement of yellow bricks on the left side of the hearth. Directly beneath them was a large flat oblong stone, weighing about 150 pounds. To the right of it, at the same level, were several smaller flagstones, obviously part of the hearth also. The bricks and paving stones were surrounded by ashes and charcoal. The majority of the specimens recovered were found in the ash bed above the floor of the fireplace.

In clearing around the outside on a level with the fireplace, we found the remains of what probably had been a shelter at the southwest side. To judge from the amount of ashes and charcoal present, this shelter had evidently burned down. Enough identifiable wood material remained to ascertain that pine was used in the structure. Unfortunately, more could not be determined about it, as the sand bank had been considerably eroded in this part of the area. An iron hammer resembling a cobbler's hammer with iron shanks at the handle end was found in association with the ashes.

Both native Indian and Colonial materials were found in the fireplace.

The Indian material consisted of 25 flakes and chips of red and black flint, and a broken reject artifact of dark flint.

Among the European material were 22 pieces of white kaolin pipestems, 7 complete pipe bowls of which three were marked with the initials PG on the heel, 1 fragmentary pipe bowl, 17 lead buckshot balls about .26 caliber, 8 balls about .38 caliber, 2 lead balls about .70 caliber, a dark gunflint, 6 small pieces of blue china plate, 39 hand-wrought iron nails, and 26 pieces of clay bricks, mentioned above. These were crudely fashioned, not all of the same dimensions and somewhat smaller than modern building bricks. There were five whole bricks in the collection. There were also found two pieces of reddish-clay pipe bowls, which seem to have been fashioned in crude imitation of the European kaolin pipes.

Leisure time at the hearth was not only spent in "drinking smoke," as the custom was known in the early seventeenth century but apparently also in more artistic pursuits. This evidence we find in the form of a flat bit of diamond-shaped bone, three quarters of an inch in length, carefully cut to shape and carved on its face with a sharp tool (Fig. 2, D).

The dating of this fireplace may be bracketed by the finds through comparing the specimens with similar objects of known date.

It is a matter of history that the Dutch, during the colonization of New Netherland, imported numerous lots of bricks from the Continent. These bricks served as ballast in the holds of their ships, which went back laden with products of the New World, especially furs. The white kaolin pipes, however, are a more sensitive time indicator, because clay pipes are not so indestructible as the bricks. In addition, it is known and recorded that several styles of pipes were in vogue among the pipemakers since the first "Elizabethan" or "fairy" pipes appeared in the latter part of the sixteenth century, with the introduction of the smoking habit by Ralph Lane in 1586. Tobacco at this early date was quite an expensive luxury, and pipe bowls were thus necessarily small. The pipe bowl illustrated (Fig. 2, A) is one of the typical bowls found in the fireplace. The bowl is barrel-shaped, slanting upward obliquely from the stem. It has a milled edge around the rim, as if made with a small coin. The bottom of the bowl terminates in

a flat "heel," which was typical of the seventeenth-century pipes and was supposed to hold the pipe in an upright positon when placed on a flat surface. The fact that this heel changed its shape into a pointed spur a century later may belie the efficacy of the heel for supporting the pipe. Of particular interest for the antiquarian are the pipemakers' trade marks, generally found on the heel (Fig. 2, C). These were usually the pipemaker's initials impressed in relief within a circle. A search through the lists of

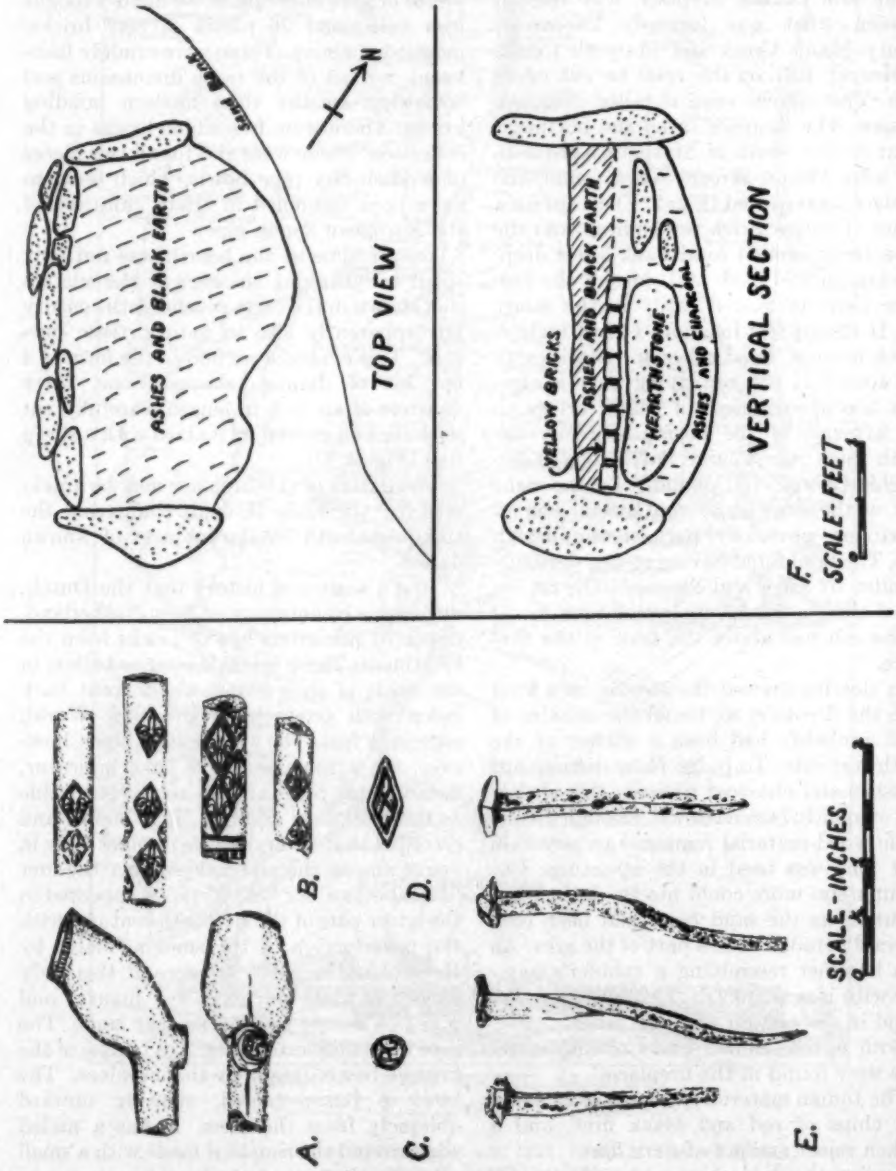

FIG. 2.—The Maspeth fireplace and artifacts: A, B, European pipe bowl and stems: C, Heel of pipe bowl with maker's impression "PG." D, Worked bit of bone. E, Wrought-iron nails. F, Top view and vertical section of the fireplace.

pipemakers of Hull and Bristol, England, will identify many of the pipes brought to America. A good many of these were used in the Indian trade. The Dutch had lively pipe manufactories also, which they seem to have copied from the English. They also kept a brisk business in pipes overseas. We do not have any data on the pipemaker "PG," whose stamp was found on three of the pipebowl heels, but from comparison of the type bowl with pipes of known date we can place the date of manufacture about the middle of the seventeenth century. The fleur-de-lis design found on eight of the pipestem pieces (Fig. 2, B) is also a good time marker, as it was popularly impressed on stems about this period. The holes in the pipestems were large, and the stems were about 8 inches long, tapering toward the mouthpiece. The so-called "church-warden" pipes, with the long stems for the cool smoke, did not make their appearance until considerably later in pipemaking history.

CONCLUSION

We may well speculate whether this fireplace had been part of Reverend Doughty's settlement and had been destroyed by the Indians during their depredations here, as the material evidence seems to be coeval. This is important to the historian, but of interest and significance to the archeologist is the presence of the flint chips. These point to associations of the whites with the Indians. We cannot say definitely that the fireplace was not of Indian construction, but from what we know of early Colonial and Indian fireplaces, the possibilities are greater that this fireplace had been made by the settlers. How to explain the presence of the flint chips other than that they demonstrate the contact period between the whites and Indians is a moot point. This borderline phase of our early history had not received the research and attention it justly deserves by archeologists.

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CHEMISTRY.—*A study of dithizone as a reagent for indium.*[1] IRVING MAY[2] and JAMES I. HOFFMAN, Lecturer in Chemistry at The George Washington University.

Indium is generally found in nature as a trace constituent of zinc ores and is obtained commercially from the residues of zinc distillations. Sensitive methods for determining indium in the presence of zinc are therefore of importance in the analysis of indium-bearing materials.

The spectrographic method is the most common one in use for determining small amounts of indium, and only a few colorimetric methods are described.

Therald Moeller (*1*) developed a colorimetric procedure for estimating small amounts of indium based upon a chloroform extraction of the indium derivative of 8-hydroxyquinoline. This method has the disadvantages of being somewhat insensitive and of being subject to numerous interferences. Nevertheless, it is capable of effecting a number of important separations and is useful for isolating indium from many metals.

The reaction of dithizone with indium was first reported by Hellmut Fischer in a brief statement which is given in translation:

> Indium is one of the few trivalent cations which react with dithizone. To be sure, solutions of trivalent indium salts, upon shaking with a solution of dithizone dissolved in carbon tetrachloride, give a red coloration in the carbon tetrachloride

[1] From a thesis submitted by Irving May to the faculty of The George Washington University in partial fulfillment of the requirements for the degree of master of science, February 1948. Received August 13, 1948.

[2] Present address, U. S. Geological Survey, Washington 25, D. C.

sion "PG." D, Worked bit of bone. E, Wrought-iron nails. F, Top view and vertical section of the fireplace.

phase only when a very definite and narrow pH range (between 5 and 6) is maintained. The reaction also proceeds in the presence of cyanide ion, if the solution is previously brought to the above mentioned pH range. The dithizone complex is decomposed merely by washing with a dilute ammonia solution (1 part of ammonia to 1000 parts of distilled water). Further investigation of the composition of the complex and its analytical application have not yet been carried out (*2*).

Subsequent investigators of the dithizone reagent have not published any additional material on its reaction with indium. Wichmann (*3*), in a comprehensive review of the dithizone system, stated that indium, as well as ferrous iron, manganese, and trivalent thallium "react with dithizone under certain conditions, but their dithizonates are of limited stability and probably of no analytical significance. The field for further investigation is still wide open."

It was thought that a more thorough investigation of the reaction of indium with dithizone than had been made by Fischer might lead to a useful method for the determination of indium. A general study was therefore made of the reaction of indium with dithizone. Tentative procedures were then developed for separating indium from other metals and its determination with dithizone.

The authors are aware of the fact that further work on this subject would be highly desirable. Unfortunately, it is unlikely that they will be in a position to pursue this study any further, but enough new information concerning the reaction of indium with dithizone has been developed to make its publication of value to others interested in this subject. It is believed that the tentative methods developed will be useful for determining indium in many types of materials.

THE REACTION OF INDIUM WITH DITHIZONE IN CARBON TETRACHLORIDE SOLUTION

The optimum conditions for the extraction of indium by carbon tetrachloride solutions of dithizone were determined. The absorption characteristics and the stability of indium dithizonate were next investigated. Similar studies were also made employing chloroform as the solvent.

The color of indium dithizonate in carbon tetrachloride and in chloroform solutions is rose-red. It was observed that carbon tetrachloride solutions of indium dithizonate underwent a visible reddening in color on standing exposed to afternoon room light.

The absorption curve of indium dithizonate in carbon tetrachloride medium was measured. A solution for this purpose was prepared by shaking a carbon tetrachloride solution of dithizone (0.001 percent wt/vol, that is, carbon tetrachloride containing 10 mg. of dithizone in a liter) with an excess of an indium nitrate solution at pH 5.8, avoiding any exposure to light. Part of the dithizone layer was drawn off and the absorption curve was measured. The absorption curve was also determined on another portion of the sample which had been permitted to stand for 22 hours in the absence of light. These curves are shown in Fig. 1 as is the curve of the 0.001 percent dithizone solution.

The curve for the dithizone solution agrees closely with similar ones previously published (*4*, *5*). The absorption curves for indium dithizonate are very similar to those for other metal dithizonates. The maximum absorption of indium dithizonate is at 510mμ, at which wavelength dithizone has a minimum absorption.

Comparison of the two indium dithizonate curves reveals that, on standing, there is a small but definite increase in optical density in the regions of 510 and 600mμ. The aging effect over a short period of time, such as an hour or less, is not likely to result in serious errors in quantitative work.

Indium dithizonate solutions in carbon tetrachloride were found to be sensitive to light. A portion of indium dithizonate solution, prepared as described above, was exposed to afternoon room light for 1½ hours. The optical density at 510 mμ changed from 0.688 to 0.713, whereas an unexposed portion of the sample changed to 0.693.

Exposure to the intense light of a 750 W projection bulb resulted in appreciable decomposition of the dithizonate. The light was focused on the sample, and heat was removed by heat-absorbing filters. Samples were exposed for 5 and for 15 minutes. The

samples looked green when first removed from the light, and some recovery of color was apparent in the short interval that elapsed before the measurements could be made. The optical density changed from an initial value of 0.688 to 0.664 for a 5-minute exposure and to 0.465 for a 15-minute exposure. After standing in the instrument for 10 minutes, the density of the 15-minute sample increased to 0.512 and then remained unchanged. This behavior is similar to that of mercury dithizonate.

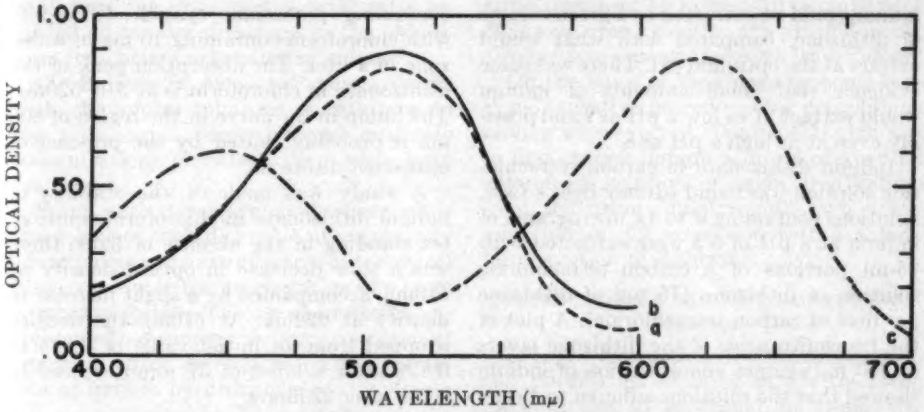

FIG. 1.—Absorption curve of indium dithizonate in carbon tetrachloride solution: *a*, Absorption curve of freshly prepared indium dithizonate solution; *b*, Absorption curve of indium dithizonate solution after standing for 22 hours; *c*, Absorption curve of the dithizone reagent, in carbon tetrachloride. (The same general form of curve is obtained with chloroform as the solvent.)

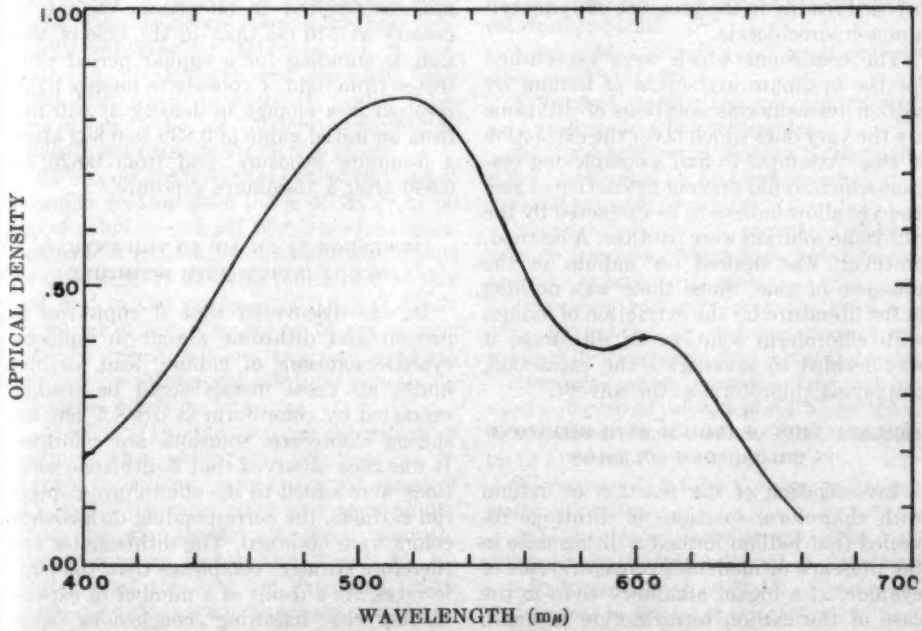

FIG. 2.—Absorption curve of indium dithizonate in chloroform solution.

The optimum pH range for the extraction of indium by carbon tetrachloride solutions of dithizone was found to be between 5.2 and 6.3, agreeing with the values given by Fischer (pH 5–6). Some extraction occurs on either side of this range. Thus, at a pH of 4.8 or 6.7, about 60 percent as much indium could be extracted by a given volume of dithizone, compared with what would extract at the optimum pH. There was some evidence that small amounts of indium would extract at as low a pH as 2 and possibly even at as high a pH as 8.

Indium dithizonate in carbon tetrachloride solution was found to obey Beer's Law. Solutions containing 0 to 14 micrograms of indium at a pH of 5.5 were extracted with 15-ml portions of a carbon tetrachloride solution of dithizone (16 mg of dithizone per liter of carbon tetrachloride). A plot of the transmittancies of the dithizone layers at 490 mμ against concentration of indium showed that the solutions adhered to Beer's Law.

It was found that the presence of citrates or tartrates prevented the extraction of indium by dithizone, but extraction did proceed readily in the presence of hydroxylamine-hydrochloride.

The conditions which were established for the optimum extraction of indium by carbon tetrachloride solutions of dithizone are the very ones which favor the extraction of zinc. Attempts to find a complexing reagent which would prevent extraction of zinc and yet allow indium to be extracted by the dithizone solution were fruitless. A method, however, was desired for indium in the presence of zinc. Since there was nothing in the literature on the extraction of indium with chloroform solutions of dithizone, it was decided to investigate the extraction, employing chloroform as the solvent.

THE REACTION OF INDIUM WITH DITHIZONE IN CHLOROFORM SOLUTION

Investigation of the reaction of indium with chloroform solutions of dithizone revealed that indium formed a dithizonate in the presence of moderate concentrations of cyanide, at a higher alkalinity than in the case of the carbon tetrachloride medium. Maximum extraction of indium occurred in the pH range 8.3 to 9.6. Extraction of indium was very incomplete at pH below 7 and above 10.

The absorption curve of a chloroform solution of indium dithizonate was measured (Fig. 2). The dithizonate was prepared by extracting a solution of indium nitrate containing potassium cyanide (pH = 9.1) with chloroform containing 10 mg of dithizone in a liter. The absorption peak of the dithizonate in chloroform is at 510–520mμ. The hump in the curve in the region of 600 mμ is probably caused by the presence of unreacted dithizone.

A study was made of the stability of indium dithizonate in chloroform solution. On standing in the absence of light, there was a slow decrease in optical density at 510mμ, accompanied by a slight increase in density at 620mμ. At 510mμ the density dropped from an initial value of 0.845 to 0.822 after a lapse of 37 minutes, and to 0.798 after 22 hours.

Unlike carbon-tetrachloride solutions of indium dithizonate, chloroform solutions of the dithizonate were found to be fairly stable to light. Exposure to room light for 45 minutes resulted in no greater change in density at 510 mμ than in the case of the sample standing for a similar period protected from light. Exposure to intense light resulted in a change in density at 510 mμ from an initial value of 0.839 to 0.862 after a 5-minute exposure, and from 0.820 to 0.840 after a 15-minute exposure.

CUPFERRON AS AN AID TO THE EXTRACTION OF INDIUM WITH DITHIZONE

It was discovered that if cupferron is present and dithizone absent in aqueous cyanide solutions of indium, lead, or bismuth, all these metals could be readily extracted by chloroform at pH 8.5 The resulting chloroform solutions are colorless. It was then observed that if dithizone solutions were added to the chloroform-cupferron extracts, the corresponding dithizonate colors were obtained. The dithizonates are therefore stronger complexes than the cupferrates. As a result of a number of experiments, the following conclusions were reached concerning the extraction of indium

from solutions at a pH of 8.5 containing cyanide:

(1) In the presence of cupferron, but in the absence of citrate, indium is extracted by chloroform even if no dithizone is present.

(2) In the presence of both citrate and cupferron, the extraction is sufficiently retarded to require dithizone in the chloroform for efficient extraction of indium.

(3) Indium is extracted more readily with chloroform solutions of dithizone in the presence of cupferron and moderate concentrations of citrate than when both are absent.

When extractions are made from alkaline solutions with dithizone, it is generally advantageous to have citrates (or tartrates) present to avoid the precipitation of a large number of metals. The use of cupferron enables one to overcome the very pronounced retarding effect of citrates on the extraction of indium by dithizone.

SEPARATION OF INDIUM FROM ZINC AND OTHER METALS

The conditions established above for the extraction of indium by chloroform solutions of dithizone are essentially those generally employed for the extraction of lead. Bismuth, bivalent tin, and univalent thallium also form dithizonates under these conditions. Zinc, in moderate concentrations, is not extracted with this group.

It was determined that concentrations of cyanide greater than 0.3 g of KCN in 60 ml of solution at a pH of 8.5 hinder the extraction of indium by chloroform solutions of dithizone. It was also found that at this pH and in the presence of 0.3 g of KCN in 60 ml of solution, up to 10 mg of zinc may be present without any zinc being extracted by chloroform solutions containing 10 mg of dithizone in a liter.

Moeller (*1*) found that on extraction of indium with chloroform solutions of 8-hydroxyquinoline (oxine) at a pH range of 3.2 to 4.5 the interfering ions were aluminum, gallium, thallic, stannous, bismuth, cupric, ferrous, nickel, and cobalt. He reported that the ions not extracted under these conditions were magnesium, calcium, strontium, zinc, cadmium, mercuric, stannic, lead, manganous, chromic, and silver.

It can be seen that, with the exception of bismuth, extraction with oxine will separate indium from the metals which otherwise would interfere with the extraction of indium by dithizone. A procedure published by Hubbard (*6*) for the separation of bismuth from lead by extracting bismuth with dithizone from a solution at a pH of 3 would also serve to separate bismuth from indium.

On the basis of the foregoing considerations, tentative procedures for determining indium were evolved. The general plan was to first extract indium at a pH of 4 with a chloroform solution of oxine, free indium from the oxine complex, and then determine indium by extraction with a chloroform solution of dithizone.

PROCEDURES FOR THE DETERMINATION OF INDIUM

Detailed instructions for the preparation and purification of most of the following reagents are to be found in papers by Clifford and Wichmann (*4*), and Bambach and Burkey (*7*).

Water.—Double-distilled in an all-Pyrex still, or otherwise prepared so that it yields a satisfactory blank.

Nitric acid, conc.—Reagent nitric acid distilled in a Pyrex still.

Nitric acid, 1:99.—Ten ml of conc nitric acid made up to a liter with water.

Sulphuric acid, conc.—Select a bottle having a low blank value for lead and indium.

Perchloric acid, 60 percent.

Potassium cyanide, 10 percent.—Potassium cyanide frequently has a high metal content and may require purification.

Ammonium hydroxide, conc. (sp. gr. 0.9).—May be purified by distilling reagent ammonium hydroxide into double-distilled water.

Ammonia-cyanide mixture.—Two hundred ml of a 10-percent solution of KCN and 150 ml of concentrated ammonium hydroxide made up to 1,000 ml.

Chloroform.—U.S.P. or C.P. grades are generally satisfactory.

Dithizone solution. 0.001 percent.—Ten mg of dithizone dissolved in 1,000 ml of chloroform.

8-Hydroxyquinoline. 0.02 M.—Dissolve 1.5 g of reagent in 500 ml of chloroform.

Buffer. pH 4.—Dilute 115 ml of acetic acid

with about 500 ml of water, titrate with ammonium hydroxide to a pH of 4.0, and dilute to 2 liters with water.

Cupferron, 1 percent.—Dissolve 1 g of cupferron in 100 ml of water. A clear colorless solution should be obtained with a good grade of cupferron. Prepare *immediately before* use.

Sodium citrate, 20 percent.—Two hundred grams of the dihydrate in a liter of water.

M-Cresol purple indicator, 0.1 percent.

Methyl orange indicator, 0.1 percent.

DOUBLE EXTRACTION PROCEDURE WITH OXINE SEPARATION

The following procedure permits the presence of more than 10 mg of zinc. Lead, thallium, and tin are separated from indium and do not interfere. The presence of large amounts of tin and aluminum may give low results.

1. Dissolve the sample in nitric acid and evaporate. If tin is present, dissolve in hydrochloric acid, add bromine, and evaporate to dryness.

2. Dissolve the residue in a few drops of nitric acid (hydrochloric, if used in no. 1) add 0.5 ml of sodium citrate solution and 10 ml of water. (If thallium is present and the treatment of the sample has resulted in its oxidation, add 1 ml of 20-percent hydroxylamine-hydrochloride.)

3. Add 2 drops of methyl orange indicator and adjust to orange color (pH 4) with 1:4 ammonium hydroxide.

4. Add 25 ml of the buffer solution and transfer the sample to a separatory funnel.

5. Extract with four 5-ml portions of a 0.02-M chloroform solution of oxine.

6. Wash the oxine extracts with 25 ml of the buffer solution.

7. Drain the oxine extracts into a 100-ml Kjeldahl flask, wash the buffer solution with a 5-ml portion of the oxine solution, and add the oxine wash to the flask.

8. Add 1 ml of sulphuric acid and heat until the chloroform is volatilized. Destroy organic matter by adding 1 ml of nitric acid and heating gently until the reaction subsides. Add 1 ml of perchloric acid, heating gently at first and then vigorously until fumes of sulphuric acid are evolved.

9. Add 25 ml of water and 1 ml of 20-percent sodium citrate solution. If iron is present, add 1 ml of 20 percent hydroxylamine-hydrochloride. Heat the solution and boil gently for a few minutes.

10. Cool and add 2 drops of m-cresol purple indicator and then ammonium hydroxide until the indicator turns orange. Add 3 ml of 10-percent potassium-cyanide solution and then add ammonium hydroxide until a purple color is obtained.

11. Wash the sample into a separatory funnel and add 5 ml of a 1-percent cupferron solution.

12. Extract with 5-ml portions of 0.001-percent chloroform solution of dithizone until the dithizone no longer changes color.

13. Add 50 ml of 1:99 nitric acid to the dithizone extracts and shake for 1 minute.

14. Discard the dithizone layer, wash the nitric acid extract with 5 ml of chloroform, and then remove the chloroform completely.

15. Add 5 ml of the ammonia-cyanide mixture to the nitric acid extract, or to an aliquot of it made up to 50 ml with 1:99 nitric acid.

16. Add 15.0 ml of a standardized 0.001-percent dithizone solution and shake for 1 minute.

17. Read the dithizone layer in a spectrophotometer at 510mμ.

The dithizone solution is standardized by taking solutions containing 0 to 15 micrograms of indium and 1 ml of sulfuric acid through the procedure, beginning at step no. 9. A blank determination should be run through the entire procedure.

If bismuth is to be separated, the above procedure should be followed through step no. 14. Then adjust the pH to 3.0 by adding dilute ammonium hydroxide, using m-cresol purple indicator. Extract the bismuth with dithizone (the extraction is slow). Wash the aqueous layer with chloroform. Add the proper volumes of ammonium hydroxide and potassium cyanide solutions to bring conditions to step no. 16 and continue with steps nos. 16–17.

SINGLE EXTRACTION PROCEDURES

In many cases it would be quite possible to use a simpler procedure than the one outlined above. Thus, the following modifications could be made in a limit test for indium in zinc samples:

A dilute nitric-acid solution of the sample is adjusted with ammonium hydroxide (m-cresol purple) to an orange color. Three ml of 10-percent potassium-cyanide solution are added, and the adjustment of pH is continued until a purple color is obtained. The sample is extracted for 3 minutes with 15.0 ml of 0.001 -percent dithizone solution. The dithizone extract is then compared with indium standards, 0 to 15 micrograms of indium, which have been taken through the same procedure. This comparison may be made visually, or in a spectrophotometer at 510 mμ. Lead, bismuth, and thallium, if present, would be read as indium. High concentrations of tin, iron, and aluminum would probably cause low results. A variation of this simplified procedure would be the addition of sodium citrate before neutralization, and cupferron before extraction.

Another variation in the procedure may be employed where the greatest accuracy and sensitivity are not necessary. The procedure outlined above is followed through step no. 11. Then the sample, or a suitable aliquot thereof, is extracted with 15.0 ml of dithizone-chloroform solution, and the transmittancy is read at 510 mμ. Standards, containing 1 ml of sulphuric acid, should be run beginning with step no. 9.

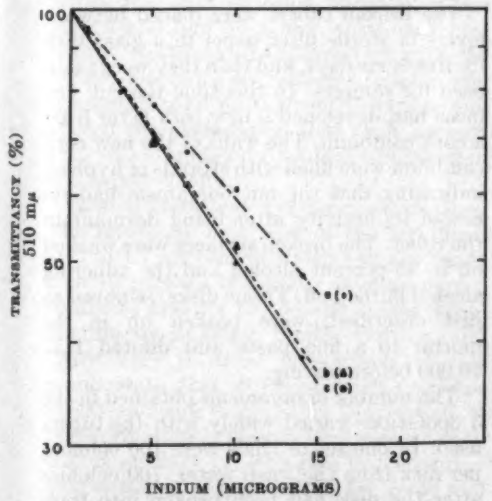

FIG. 3.—Indium dithizonate standards:
a, Single extraction procedure. Extraction in presence of sulphate, citrate, cyanide, and cupferron;
b, Double extraction procedure;
c, Single extraction procedure. Extraction in the presence of citrate, cyanide, and cupferron (sulphate absent).

TABLE 1

Foreign metal initially present		Indium added	Indium found
Metal	Amount		
		micrograms	micrograms
—	—	1.0	1.2
—	—	3.0	3.0
—	—	5.0	5.2
—	—	9.0	8.7
—	—	10.0	9.2
—	—	14.0	13.1
Cu	10 mg	10.0	10.5
Pb	10	10.0	9.3
Fe	0.5	10.0	10.2
Ni	5	10.0	9.3
Co	5	10.0	9.0
Zn	10	10.0	9.0
Ga	5	10.0	11.5
Sn	10	10.0	5.0
Al	5	10.0	5.2
Al	10	10.0	5.3
Mn	5	10.0	8.4
Cd	5	10.0	8.4
Tl	5	10.0	8.1

RECOVERY OF KNOWN AMOUNTS OF INDIUM

Standardization of the same batch of dithizone solution by three of the above-mentioned procedures is shown in Fig. 3. Comparison of curves *a* and *c* indicates that there is a loss of sensitivity when the extraction is performed in the presence of high concentrations of ammonium sulphate.

The results for the recovery of known amounts of indium obtained with the procedure employing an oxine separation followed by a single extraction of indium are given in Table 1.

It will be observed that poor recoveries of indium were obtained in the presence of high concentrations of tin and aluminum. Samples containing much tin could probably best be handled by completely volatilizing the tin as stannic bromide from perchloric acid solution by the procedure of Wichmann and Clifford (*8*).

SUMMARY

The extraction of indium by carbon tetrachloride and chloroform solutions of dithiz-

one has been studied. Indium was found to be extracted with chloroform solutions of dithizone under the same conditions as the lead, tin, thallium, and bismuth group. Tentative procedures have been presented for the separation of indium from various metals and its determination by dithizone methods.

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PLANT PATHOLOGY.—*Bacillus megaterium de Bary from the interior of healthy potato tubers.*[1]

BENJAMIN FRANKLIN LUTMAN and HARRY E. WHEELER, Department of Botany and Plant Pathology, Louisiana State University. (Communicated by NATHAN R. SMITH.)

For several years the writers have been attempting to grow microorganisms from the filamentous plant intercellular inclusions which had been described by Lutman (*6*, *7*). Various methods were used to induce them to leave their intercellular habitat and grow in another medium, but without success. Although a few actinomycetes were occasionally obtained, no assurance could be given that they were not accidentally introduced in the transfer of material from tubers to medium.

The technique that was used in the following work was neither new nor complicated. Burbank Russet tubers, grown in Idaho, were used for much of this work because they were available in the market and their long shape made them easy to break. At the time most of these trials were made these mature tubers showed sprouts, indicating that the rest period had been passed.

Clean, selected tubers were disinfected for 2 hours in 0.5 percent formaldehyde solution. They were dried and then cut on one side so that they could be broken readily. Disks of tuber tissue were removed with a sterile cork borer and a scalpel. Usually three or four of these circular disks (1 cm across and 1–2 mm thick) were taken from the broken surfaces and removed to bottles of sterile water. After washing they were placed in a small, sterile porcelain mortar, ground to a fine paste, and transferred to another similar flask of sterile water. The material from these flasks was plated out on nutrient agar to which had been added 2 percent dextrose and 1 percent yeast extract.

The broken tubers were placed between layers of sterile filter paper in a glass dish for five or six days, and then they were again used for samples. In this time the cut surfaces had developed a new cork layer from a cork cambium. The walls of the new cork cambium were filled with strands of hyphae, indicating that the microorganism had renewed its activity after being dormant in the tuber. The broken surfaces were washed off in 95 percent alcohol and the adhering alcohol burned off. Tissue disks, removed as just described, were broken up in the mortar to a fine paste and diluted 1 to 10,000 before plating.

The number of organisms obtained in the 3 operations varied widely with the tubers used. In one set of trials were 100 colonies per disk from the wash water, 700 colonies after the disk had been broken into fragments, and 33,000 from the disks taken from the regenerated skin. In another trial the numbers were 300 from a washed disk, 1,200 from a ground-up one, and 48,000 from a disk from a regenerated skin layer.

[1] Received August 5, 1948.

The organisms obtained, however, were not actinomycetes, but a large, curved-rod bacillus which was easily identified as the highly pleomorphic de Bary organism, *Bacillus megaterium*.[2] Occasionally, colonies of other organisms appeared on the plates, but the predominant form was always this bacillus.

For a long time these organisms were regarded as intruders from the soil and were disregarded. But, since they were so frequent, even with all precautions taken against the introduction of soil bacteria, a more careful examination was made of the colonies and of the individuals composing them. For this purpose the colonies that resulted from plating out the tissues were used, their age usually being 24 to 72 hours.

Colony margin.—The filaments protruding from the margins of the colony frequently showed branching, although in some colonies the individuals were pressed together in parallel, concentric circles to form a smooth margin. The most striking variation from an ordinary bacterial colony was the long filaments that would break away from the colony margin to push out across the agar to some distance, where they would bud off a new, small daughter colony. Rettger and Gillespie (*9*) gave the appropriate name of "runners" to these long nonseptate and unfragmented hyphae and offered the explanation that their appearance was stimulated by a lack of oxygen in the parent colony.

Reproduction and unusual individuals.—The unusually large size of the organisms (1.2 to 1.7 microns in width and averaging 5 to 10 microns in length) gave an opportunity to observe the details of cell reproduction by budding. Smith, Gordon, and Clark (*10*) in their monograph of this group state that *B. megaterium* produces apical and side buds. This description of bud formation is shorter and clearer than that of de Bary (*2*) who goes into considerable detail in the growth of the buds and the curvature of the rods: "The rods divide by the formation of a transverse septum into two members, the transverse septa are extremely delicate when young. When two sister rods begin to separate transversely from one another, the curvature usually becomes more pronounced at the extremities where division takes place, and the ends of the rods become slightly oblique to one another and overlap each other a little, or one thrusts itself laterally past the other, like the short commencement of a so-called false branch in Syctonema and similar genera of the Nostcaceae." His figure, however, shows clearly side buds, although all buds originate near cell apices.

Budding would automatically deny the name of the group to which it had been assigned, the Schizomycetes (fission-fungi). As a result of the buds and continued apical growth, true branching is common in the cells of these colonies derived directly from potato tissue. On replating these colonies, however, the branches or buds were shorter, so that the curved rods usually considered typical for this species now predominated. Rettger and Gillespie (*9*) had noted that these so-called "abnormalities" were always more frequent near the colony margins where oxygen supply was more abundant. At the centers and in the depths of the colonies fragmentation into short curved rods introduced the "normal," i.e., the laboratory type, of the species. The long filaments, branching cells, etc. were not permanent, but would resume their normal form if returned to any of the standard media (*4*).

Spore formation and sheath.—Occasional long filaments may be seen in the colonies. They fragment by the introduction of biconvex vacuoles. The protoplasm retreats and the empty space enlarges and becomes biconcave. This fragmentation is marked near the end of a filament where the protoplasm frequently fragments in a short branch into three or four capsule-shaped spores enclosed in a clear sheath. These short rows of spores are usually curved as are those of the actinomycetes. These spores would be the conidia of these latter filamentous species and are to be distinguished from the endospores described in some strains of *B. megaterium* but which are absent in other strains, and may be lost occasionally from those having them (*5*).

[2] The authors will use the original de Bary spelling.

No endospores were observed on these strains when grown on dextrose agar.[3]

Rettger and Gillespie (*8*) noted so-called "empty sausage" skins (sheaths empty of protoplasm) but did not consider them of special importance, presenting their observations "as a matter of general interest, rather than as evidence of the occurrence of a highly specialized cell membrane or envelope in bacteria." They did not call attention to the fact that the actinomycetes have such an envelope or sheath, even if other microorganisms do not. This envelope or skin has been investigated by a number of electron microscope workers. Dubin and Sharp (*3*) arrived at the conclusion that "electron micrographs indicate plainly the presence of two structures constituting the bacterial cell, an inner dense substance and outer less dense substance. The outer substance of the bacterial cell is invisible in light micrographs." To the latter statement, the authors would in part disagree, since this sheath may often be seen between the fragments of protoplasm, especially after dense staining.

Germination of the intercellular strands.—The best proof of the origin of the colonies from the intercellular filaments would be to grow them from between the cells out into a culture medium. In order to demonstrate this point a somewhat different technique was used.

Some of the ground-up regenerated cork layer in a 100-cc water suspension was pipetted on large (24 by 50 mm) cover glasses, where it was allowed to air dry. A thin layer of the nutrient agar used in the plates was then spread over these dried tissue fragments. After it had hardened the cover glass was inverted over a slide, the ends of the cover glass being suspended by fine glass rods. The slide was then placed in a damp chamber.

In a warm room germination would begin in about two to three hours. Probably more than 90 percent of the germinations would have no connection with bits of tissue. They seemed to originate in fragments of mycelium loosened from their intercellular attachments by the pounding in the mortar. No indication of remains of a spore could be seen even in the early 1- and 2-celled stages. They were bits of mycelium free from all tissue connections. This fact would indicate that the mycelium is not deeply imbedded in the pectin of the intercellular region.

An occasional filament can be traced back into strands inside the tuber tissue. Such a filament will be seen to break up in the culture medium into the rods of *B. megaterium*. In the two figures shown, the dried tissue had been covered with agar at 11:30 A.M. When examined and photographed at 2:30 P.M. the filament was projecting into the medium and had thrown off a long bud, which lay parallel to it. The growth was rapid during the first half hour, but a series of five exposures were made of which only one, that at 4:30 is reproduced. At this time the true point of origin of the cluster of bacilli could be determined only by referring back to the earlier stage.

A careful study of such filaments germinating from tissue showed that in every case the part in the tissue lay close to the margin and that all connection with the hyphae of the cells had been broken. In no instance was a germination observed from the end of a hyphae extending unbroken back into the tissue.

Occurrence in other parts of the potato plant and in other plants.—No extended efforts were made to isolate *B. megaterium* from other parts of the potato or from other plants. It was noted that, with the same technique used, this organism was common in disinfected sweet potatoes and also in potato roots after they had been washed and dipped in 95 percent alcohol from 10 to 15 seconds before crushing them up in the mortar. The same is true of garden carrots.

Since the Burbank Russet potatoes were mature and had been in storage for at least four months, the same technic was used on small Bliss' Triumph tubers taken fresh from the soil and larger tubers of the same variety grown in Florida. The same organisms appeared as when the storage tubers had been used.

[3] The writers wish to thank Dr. Nathan R. Smith for the additional information that the three isolations sent to him after this work was done readily produced spores on the ordinary beef agar.

Sheath on the hyphae in the tubers.—No note was taken of the occurrence of a sheath on the filaments stained in the intercellular regions of the potato tuber by Lutman (7), but such a sheath shows distinctly in many of the photographs, especially those of sections of mature tubers. In one of the illustrations of these filaments in the turnip, the tube is shown cut through in such a manner that the organism inside it was missed and the tube in part seemed empty. As shown in the same paper the enclosed filaments were also Gram-positive, although a special timing and technique had to be used to demonstrate them.

Tissue cultures with sterile material.—The interior of healthy plants was formerly held to be free from bacteria and sterile. Tissue cultures have been made of many organs without any evidence of bacterial growths on the bits of tissue. The reason for this apparent freedom from bacteria is due, so far as *B. megaterium* is concerned at any rate, to its marked aerobic habit. It will not grow in a stab in a solid culture medium to a depth of much more than two millimeters. In tissue-culture technique, the bits of tissue are covered with the nutrient fluid to a depth sufficient to stifle the growth of this highly aerobic species. If growth should start, the colonies would be so small owing to lack of oxygen that they have been overlooked.

Systematic position of the organism.—The question arises at once in the mind of any systematist of microorganisms of the naming and grouping of the pleomorphic species which lives part of its life as a branching mycelium inside plants and breaks up into short, motile bacilli in culture media.

In the sixth edition of Bergey's *Manual of determinative bacteriology* (*1*), Order II. *Actinomycetales* Buchanan has as family I. *Mycobacteriaceae* Chester, a single genus: I. *Mycobacterium* Lehmann and Neumann. This group contains many important organisms such as those associated with tuberculosis and leprosy. These organisms are also filamentous at times but break up readily into nonmotile rods. *Bacillus megaterium* would not fit into such a genus since the organisms are typically motile. It can not be regarded as a true Actinomyces, although it has a sheath and the resting spores are similar to those of the latter group. No member of the Actinomyces

FIGS. 1–12.—Pleomorphic forms assumed by *Bacillus megaterium* in culture media, aqueous crystal violet stain: 1, "Runner" type with vacuoles; 2, types of short bacilli; 3, budding, and 4, bud almost separated; 5, extreme branching with variation in size of branches; 6, end of filament with empty "sausage" skin; 7–10, resting spores formed by fragmentation, spores still enclosed or connected by clear-walled sheath; 11, filament arising from a bit of potato tuber tissue with a parallel branch or bud at right, taken at 2:30 P.M.; 12, same, at 4:30 P.M. (Figs. 1 and 5–9 magnified 1,100 times, Figs. 2–4 magnified 1,350 times; 11 and 12, 400 times.)

is known, however, to have a motile stage or endospores. The intermediate position of this microorganism is clearer than its disposition in any present classification.

The middle lamellae.—To the botanist the fundamental contribution of these observations is that the denser material between plant cell walls is not a chemical (calcium pectate), as suggested by Mangin who discovered these bodies, but living microorganisms that may be grown in culture media outside the plant. Further, the old conception that the interior of plants is sterile is not tenable. The role which these microorganisms play in the physiology of the higher plants will have to be determined by future experiments, but the abundance of the filaments in enlarged roots (carrots, beets, turnips) and tubers (potato, sweetpotato, and Jerusalem artichoke) suggests the formation of some type of growth-stimulating substances. It may be pointed out that the invasion of the cork cambium of young potato tubers by a similar microorganism stimulates the cork cells to produce hypertrophied tissue known as common or corky scab.

ADDENDUM

The day following the receipt of the manuscript for transmittal to the editors of the JOURNAL, word was received of the fatal illness of the senior author of this paper. In the meantime it has come to my attention that G. B. Sanford recently published a paper in *Scientific Agriculture*, vol. 28, pp. 23–25, 1948, entitled *The occurrence of bacteria in normal potato plants and legumes*. In addition, I am informed that a manuscript by Tervet and Hollis along the same line has been accepted for publication and will shortly appear in *Phytopathology*. These and former papers seem to leave little doubt that healthy plant tissues may contain microorganisms. The frequency of their occurrence and their function still remain to be discovered. —NATHAN R. SMITH.

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ZOOLOGY.—Hesperochernes thomomysi, *a new species of chernetid pseudoscorpion from California.*[1] C. CLAYTON HOFF, University of New Mexico. (Communicated by EDWARD A. CHAPIN.)

Pseudoscorpions are common in the nests of burrowing rodents. The species found in rodent nests have received relatively little attention, however, perhaps as a result of difficulties encountered in making species determinations in the groups to which most of these forms belong. In the present paper, a new species of the genus *Hesperochernes* is described from the nest of *Thomomys monticola* from California, the description being based on material submitted by Dr. Edward A. Chapin, of the United States National Museum. The type specimens mounted on microscope slides are deposited in the National Museum. As a result of our very inadequate knowledge of chernetid

[1] Received June 7, 1948.

pseudoscorpions, the inclusion of the generic description is considered advisable.

Suborder MONOSPHYRONIDA Chamberlin, 1929
Family CHERNETIDAE Menge, 1855

Genus **Hesperochernes** Chamberlin, 1924

Hesperochernes Chamberlin, Pan-Pacific Ent. 1: 89–90. 1924; Beier, Das Tierreich 58: 174. 1932; Hoff, Bull. Illinois Nat. Hist. Survey. (In press.)

Cephalothorax clearly longer than wide; carapace granular, with two transverse carapacal furrows. Tergites divided, granular. Palpi stout, femur with well-defined pedicle. Setae of body and palps usually lightly, but clearly clavate. Flagellum with four setae; setae *b* and *sb* of hand of chelicera thickened and denticulate. The sensory seta *ist* of the fixed chelal finger is distal to *est; st* of the movable chelal finger is found nearer to *t* than to *sb*. The tarsus of the fourth leg is without a true sensory seta, although a short toothed pseudotactile seta may be present.

Genotype: *H. laurae* Chamberlin, 1924 (through original designation).

Hesperochernes thomomysi, new species

Female.—The description of the female is based on two specimens, the holotype and a paratype. The measurements of various structures of the holotype are followed in parentheses by the corresponding measurements of the paratype whenever the two differ significantly. Body stout, light yellowish brown in color; palpi deeper brown, often golden brown to reddish brown, and moderately stout; body length 3.1 (2.7) mm. Carapace light yellowish brown to golden brown, transverse furrows well marked, posterior furrow nearer to the posterior carapacal margin than to the median furrow; posterior margin well rounded, lateral margins convex and passing without interruption into the anterior margin; carapace somewhat subtriangular in shape; dorsal surface of carapace virtually smooth except for very fine netlike markings, lateral surfaces moderately granulate; setae very numerous, well scattered, terminally denticulate, not clavate; eyes not distinguished; length of carapace 0.98 (0.92) mm, width 0.96 (0.83) mm; greatest width in the posterior half of the carapace. Abdomen oval in shape, very stout; tergal halves well separated by rugose and nonsclerotic areas; setae small, mostly nonclavate, terminally denticulate, similar to those of the carapace; each tergal half of tergite 1 with eight or nine setae, maximum number of setae on any tergal half is 10; tergite 11 not divided; surface of tergites marked much like the dorsal surface of the carapace. Ventral surface of abdomen with the sternal halves well separated medially; halves of sternite 4 with two setae in holotype, with three or four in paratype; each half of sternite 5 with seven to nine setae; maximum number of setae on any sternal half is 10; setae longer and more conspicuous than on the tergites; setae of sternites acuminate. Each anterior stigmatic plate with two or three acuminate setae; each posterior plate with one seta; pleural membranes with rugose and wavy parallel striations. Abdomen 2.1 (1.8) mm in length; width 1.73 (1.42) mm.

Chelicera: Yellow in color; moderately stout; 0.28 (0.27) mm long, base 0.17 mm wide; subbasal seta of base stout, widened, with numerous terminal and subterminal denticulations; basal seta more slender and with fewer denticulations, in some instances the denticulations are difficult to observe; internal and laminal setae very long and acuminate; surface of hand unsculptured except for a roughened area in the region of the insertion of the subbasal seta; flagellum with the largest seta distinctly bladelike, a little curved, and deeply serrate along one margin throughout almost the entire length of the blade; the two proximally placed setae subequal in length and each longer than half the length of the longest blade of the flagellum. Fixed cheliceral finger with well-developed lamina exterior, markedly convex near the center of the finger; apical tooth with three or four small and rounded denticles on the inner margin; inner finger margin with four or five denticles in the distal third of the margin, the distal two heavy and conical in shape, the proximal two or three more weakly developed and more retroconical; serrula interior with four distal plates free, others fused. Movable finger stout, little curved; 0.22 (0.23) mm long; serrula exterior of 17 to 19 ligulate plates, of which the proximal one is much longer than the others; galeal seta almost reaching the tip of the galea; galea with a stout base, antlerlike, with six somewhat curved branches confined to the distal half of the galea; apical tooth sclerotic and terminally

bicuspid; subapical lobe just basal to the apical tooth and distal to the base of the galeal seta, somewhat smaller than the apical tooth and frequently blunt.

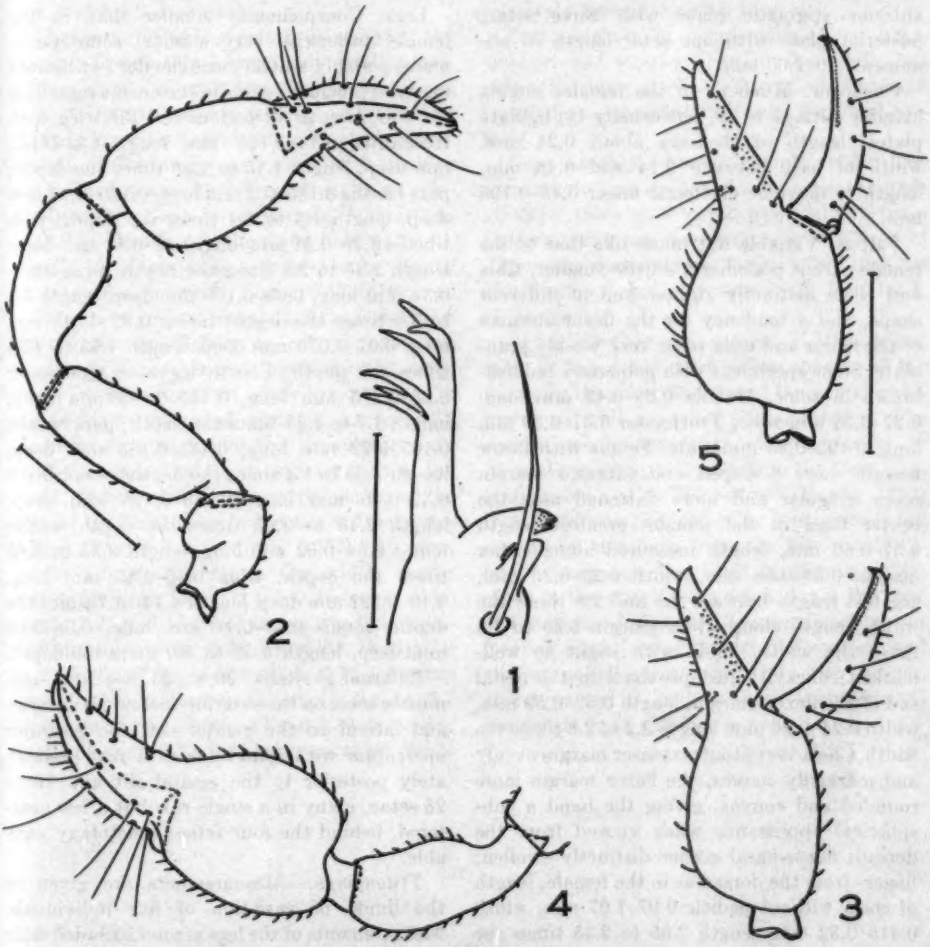
Palpus: Moderately stout; surface of podomeres virtually unmarked and almost nongranulate except the maxilla; maxilla with weakly granulate surface and with numerous, short and stout setae, many of which have a few terminal denticulations; setae of podomeres in general subclavate and fairly stout on the proximal podomeres, longer, more slender, and nonclavate on the distal podomeres, each seta with a few terminal and subterminal denticulations; investing setae of chelal fingers acuminate; color variable, deep golden brown in holotype to light yellowish brown in paratype. Maxilla 0.48 (0.43) mm long, 0.34 (0.31) mm wide. Trochanter somewhat club-shaped, pedicle stout, two protuberances present, 0.44 mm long, 0.26 (0.24) mm wide in strict dorsal view. Femur with pedicle about as long as wide and well set-off from the rest of the podomere; extensor margin very little convex in the center, more convex near the ends; flexor margin weakly S-shaped femur widest near the center; greatest over-all length 0.74 (0.73) mm, length along either the extensor or flexor margin 0.68 (0.66) mm; width 0.275 (0.26) mm. Tibia with stout pedicle; flexor margin somewhat evenly convex except towards the distal end and in the region of the pedicle; extensor margin markedly convex near the ends; length 0.67 (0.64) mm, width 0.28 (0.26) mm. Chela with hand stout and fingers fairly well separated from the hand; extensor margin of hand flatly convex, flexor margin more or less evenly and distinctly convex; hand somewhat bulging in the flexor-basal angle and the pedicle far displaced towards the extensor margin; fingers gently curved and narrowed regularly and decisively from base to distal end; length of chela 1.14 (1.08)mm, width 0.43 (0.40) mm; length of hand 0.57 (0.55) mm; length of movable finger 0.57 (0.55) mm. From the side, the chela has a subrectangular hand, with the pedicle almost at the ventral-basal corner; ventral margin weakly and evenly convex; dorsal margin more convex and, with the basal margin, forming a well-rounded angle; depth of hand 0.43 (0.41) mm; fixed finger nearly straight, more or less cone-shaped in outline and broadly joined to the hand; external aspect of fixed finger near the inner margin is conspicuously granulate; the movable finger less stout but well curved, especially in the proximal third of the finger. Each finger with between 40 and 45 marginal teeth, all with cusps and contiguous; the marginal teeth of the distal end of the row more acute and with better developed cusps than those at the proximal end of the row; fixed finger with four or five internal and four or five external accessory teeth, all confined to the distal one-half of the finger; movable finger with two internal and three to five external accessory teeth, all found in less than the distal half of the finger; nodus ramosus of movable finger somewhat nearer tactile seta *t* than *st* in the holotype and nearer *st* than *t* in the paratype. Tactile setae as usual in the genus; *st* varying from a little (holotype) to considerably (paratype) closer to *t* than to *sb*; other tactile setae as shown in the figure.

Legs: Moderately stout; yellowish brown, often very light in color; surface of podomeres nongranular; setae except on tarsi fairly heavy, subclavate, with numerous subterminal and terminal denticulations; setae of tarsi like those of other podomeres basally and on the extensor surface, but distally and on the flexor surface relatively stout and acuminate; terminal tarsal claws well curved and slender. First leg with trochanter subquadrate, 0.185 mm long, 0.147 mm deep; pars basalis distally deepened, flexor margin more or less evenly rounded, length measured along the flexor margin 0.245 (0.24) mm, depth 0.175 (0.165) mm; pars tibialis with both flexor and extensor margins evenly convex, deepest near the center, length measured along the extensor margin 0.37 (0.36) mm, depth 0.147 (0.135) mm; tibia with extensor margin weakly S-shaped, flexor margin somewhat evenly convex, 0.405 (0.39) mm long, 0.118 (0.105) mm deep; tarsus subcylindrical, flexor margin a little convex, length 0.41 (0.40) mm, depth 0.083 (0.076) mm. Fourth leg with trochanter having a very weakly but evenly convex flexor margin, extensor margin much more convex, especially in the central portion, entire podomore somewhat quadrate in outline, length 0.34 mm, depth 0.195 (0.178) mm; pars basalis subtriangular, flexor margin weakly convex to almost straight, length measured along the flexor margin 0.27 (0.25) mm, depth 0.18 (0.17) mm; pars tibialis with

flexor margin nearly straight, extensor margin evenly or flatly convex, deepest near the center, length measured along the extensor margin 0.52 (0.50) mm, depth 0.20 (0.18) mm; length of entire femur 0.73 (0.70) mm; tibia shaped much as in the first leg but much more slender, very weakly S-shaped or extensor margin virtually straight except near the proximal end, length 0.60 (0.61) mm, depth 0.125 (0.12) mm; tarsus subcylindrical but the flexor margin somewhat convex, podomere deepest near the center, length 0.47 (0.46) mm, depth 0.095 (0.09) mm.

External genitalia: Simple; anterior operculum with 14 closely clustered setae, posterior to which is found a group of 13 (11) well-spaced and well-separated setae; posterior operculum with a single row of eight (13) setae.

Male.—The collection contains four males, one of which is designated the allotype. The



HESPEROCHERNES THOMOMYSI, NEW SPECIES

FIG. 1.—Tip of movable finger of chelicera, female holotype; scale 0.05 mm. FIG. 2.—Dorsal view of palpus, female holotype; scale 0.5 mm. FIG. 3.—Lateral view of chelal hand, female holotype; scale as in Fig. 2; marginal and accessory teeth omitted. FIG. 4.—Dorsal view of tibia and chela of palpus, male allotype; scale as in Fig. 5. FIG. 5.—Lateral view of chelal hand, male allotype; scale 0.5 mm; marginal and accessory teeth omitted.

measurements given are the limits of range of the four specimens. In general, male similar to female but smaller; body length 2.0–2.4 mm; carapace 0.76–0.82 mm long, 0.62–0.73 mm wide. Abdomen usually with seven setae on each half of tergite 1, other tergal halves usually with eight or nine setae; each half of sternite 4 with three to four acuminate setae, each half of sternite 5 with seven to ten setae, maximum number of setae on any sternal half is ten, in some specimens only eight or nine; anterior stigmatic plate with three setae, posterior plate with one seta; length of abdomen 1.19–1.60 mm.

Chelicera: Much as in the female; serrula exterior with 17 to 19, but usually 18, ligulate plates; length of chelicera about 0.24 mm, width of base between 0.14 and 0.15 mm, length of movable cheliceral finger 0.18–0.195 mm.

Palpus: Variable but much like that of the female except podomeres a little smaller, tibia and chela distinctly stouter and of different shape, and a tendency for the flexor surfaces of the femur and tibia to be very weakly granulate. Some specimens with palpi dark reddish-brown in color. Maxilla 0.38–0.43 mm long, 0.27–0.28 mm wide. Trochanter 0.37–0.39 mm long, 0.195–0.23 mm wide. Femur with flexor margin more S-shaped and extensor margin more irregular and more flattened near the center than in the female; greatest length 0.57–0.66 mm, length measured along either margin 0.53–0.58 mm, width 0.23–0.25 mm, greatest length between 2.5 and 2.8 times the width, length along either margin 2.25 to 2.5 times the width. Tibia with slight to well-marked concavity just proximal to the distal end of the flexor margin, length 0.53–0.59 mm, width 0.24–0.26 mm, length 2.2 to 2.3 times the width. Chela very stout; extensor margin evenly and markedly convex, the flexor margin more rounded and convex, giving the hand a subspherical appearance when viewed from the dorsad; flexor-basal corner distinctly swollen; fingers from the dorsad as in the female; length of chela without pedicle 0.97–1.07 mm, width 0.415–0.52 mm, length 2.05 to 2.35 times the width; length of hand 0.50–0.53 mm, length of movable finger 0.53–0.62 mm. From the side, the chela of the male relatively deeper than in the female, depth 0.44–0.55 mm; ventral margin evenly but not greatly convex, dorsal margin bulging and rounded, especially in the area where it merges with the basal margin; marginal teeth about 40, varying from 35 to 45; accessory teeth extremely variable, each row with three (in one instance two) to as many as eight accessory teeth; on movable finger tactile seta *st* is nearer to *t* than to *sb* and the nodus ramosus in most individuals is conspicuously nearer to *st* than to *t*; tactile setae somewhat variable in the fixed finger but in general as shown in the figure.

Legs: Conspicuously smaller than in the female, otherwise very similar; some podomeres possibly a little more slender but limited material precludes definite statement regarding the condition in all podomeres. First leg with trochanter 0.14–0.155 mm long, 0.12–0.135 mm deep, length 1.15 to 1.25 times the depth; pars basalis 0.185–0.2 mm long, 0.135–0.15 mm deep, length 1.3 to 1.4 times the depth; pars tibialis 0.29–0.31 mm long, 0.12–0.13 mm deep; length 2.35 to 2.5 times the depth; tibia 0.31–0.35 mm long, 0.09–0.105 mm deep, length 3.3 to 3.4 times the depth; tarsus 0.32–0.345 mm long, 0.07–0.075 mm deep, length 4.55 to 4.75 times the depth. Fourth leg with trochanter 0.25–0.275 mm long, 0.135–0.155 mm deep, length 1.7 to 1.85 times the depth; pars basalis 0.195–0.22 mm long, 0.135–0.155 mm deep, length 1.35 to 1.4 times the depth; pars tibialis 0.39–0.46 mm long, 0.155–0.175 mm deep, length 2.45 to 2.65 times the depth; entire femur 0.54–0.62 mm long, length 3.35 to 3.65 times the depth; tibia 0.45–0.55 mm long, 0.10–0.122 mm deep, length 4.4 to 4.7 times the depth; tarsus 0.39–0.41 mm long, 0.08–0.09 mm deep, length 4.55 to 5.0 times the depth.

External genitalia: 20 to 25 fine and acuminate setae on the anterior operculum anterior and lateral to the genital slit; the posterior operculum with four setae in a row immediately posterior to the genital slit and 16 to 25 setae, many in a single row but a few scattered, behind the four setae; chaetotaxy variable.

Tritonymph.—Measurements are given as the limits of variation of five individuals. Measurements of the legs are not included since these may be considered of little importance to the species description. Tritonymph much like the female but smaller and lighter in color; length of body 1.9–2.5 mm. Carapace possibly a little more granulate than in the female and

the investing setae a little more clavate; length of carapace 0.67–0.76 mm, width 0.51–0.62 mm. Abdomen with each half of tergite 1 having five to seven setae, other tergal halves usually with six to eight setae; each half of sternite 4 with two to five setae, of sternite 5 with six or seven setae; maximum number of setae on any sternal half is seven; each anterior stigmatic plate with one or two setae; posterior stigmatic plate with one seta; abdomen otherwise much as in the female; length 1.35–1.8 mm, width 0.9–1.4 mm.

Chelicera: General structure like that of the female. Tactile seta *b* noticeably smaller than *sb*, less stout and with very few denticulations or appearing acuminate perhaps as a result of being in a position unfavorable for study; inner margin of fixed finger sometimes with three or six teeth but usually four or five; galea relatively stouter than in the female, four or five antlerlike branches in the distal half; 14 to 16, usually 15, plates in the serrula exterior; length of movable cheliceral finger 0.17–0.18 mm.

Palpus: In general like that of the female but on the average lighter in color; podomeres smaller in size; tibia and femur stouter; setae much less numerous but of the same type as in the adult; surface of all podomeres, especially the flexor surfaces, moderately granular; pedicle of all podomeres relatively stouter than in the adult; pedicle of chela nearer the center of the base of the hand than in the adult; trochanter 0.28–0.32 mm long, width 0.175–0.20 mm, length 1.6 to 1.75 times the width; femur 0.48–0.54 mm long, 0.195–0.21 mm wide, length 2.25 to 2.55 times the width; tibia 0.40–0.49 mm long, 0.20–0.23 mm wide, length 2.0 to 2.25 times the width; chela 0.72–0.85 mm long, 0.27–0.32 mm wide, length 2.6 to 2.7 times the width; length of hand 0.34–0.43 mm, depth of hand 0.31–0.34 mm; movable chelal finger 0.39–0.45 mm in length. From the side, the chelal hand is much more like that of the female than the male; marginal teeth of fingers nsually between 30 and 35 in a number; accessory teeth variable, one to four in each row. Movable chelal finger with nodus ramosus just proximal to tactile seta *t*; one tactile seta absent; the center one of the three tactile setae may be closer to the basal (*b* or *sb*?) or to the distal seta *t*. Fixed finger with *ist* missing; other tactile setae much as in the adult except *it* is relatively farther removed from *et*.

Legs: Lighter in color, with fewer setae, smaller, and stouter than in the adult, but otherwise very similar. Tarsus of first and fourth legs somewhat fusiform, narrowed distally.

Type Locality.—Fresno County, Calif. The female holotype, one female paratype, the male allotype, three male paratypes, and five tritonymph paratypes were taken from a nest of *Thomomys monticola* on January 27, 1947, at Huntington Lake, elevation 7,000 feet, by I. G. Ingles.

Remarks.—Our new species, *H. thomomysi*, may be separated from other species of the genus by the shape and size of the palpal podomeres as well as other characteristics. The species seems somewhat closely related to *H. sanborni* (Hagen, 1869) from the New England states and to *H. pallipes* (Banks, 1893) from California. No difficulty is experienced in separating this form from the two closely related species on the basis of characteristics given in the above description. From the type of the genus, *H. laurae* Chamberlin, 1924, our form is easily separated by the smaller and stouter palpal podomeres. Only two species, *H. laurae* and *H. pallipes*, have been reported previously from California.

ZOOLOGY.—*Three new eastern millipeds of the family Xystodesmidae.*[1] RICHARD L. HOFFMAN, Miller School of Biology, University of Virginia. (Communicated by E. A. CHAPIN.)

Through the kindness of Drs. Edward A. Chapin, Waldo L. Schmitt, and Alexander Wetmore, I have been enabled to carry on extended work on the diplopod collection of the U. S. National Museum. During the course of identifying and arranging material, a number of undescribed species have been discovered. Three of these are described below, representing three genera of the large Holarctic family Xystodesmidae.

In one instance personal field work has resulted in the independent discovery of one of the new forms, and in this case my specimen has been designated holotype, since it is a fresh one and in better condition. It has been deposited in the National Museum collection.

Two of the species are of considerable interest from a systematic standpoint, and remarks on their relationships are included. A key to the known species of the genus *Tucoria*, based on males, is also appended.

The figures illustrate the configuration of the left male gonopod, and are made from cephalic and mesial aspects following removal and orientation of the appendage. Setae have been removed in order to show basal structure.

Apheloria intermedia, n. sp.

Figs. 1, 2

Diagnosis.—Male gonopod with lateral process produced upward in the manner of *Deltotaria*, lateral spine scarcely perceptible at end; mesial process low, rounded; blade of telopodite forming a loose curve, tip of blade not bent out of line with rest of the structure.

Description of male holotype.—Length 34, width 8.2 mm. Body rather slender, gently tapering caudad, more abruptly cephalad. Segments 4 through 14 of full width.

Collum large, almost semicircular in dorsal aspect, caudal margin almost straight (lateral portion swept slightly forward), cephalic margin rather evenly rounded and swept back. Marginal ridge perceptible on lateral extremities of collum.

Second and third segments with cephalolateral corners of keels widely rounded, marginal ridges well developed. Posterior edges of tergites straight except in being tapered forward on keels.

Segments 4 through 14 subsimilar, anterior corners rounded, slightly lobed cephalad; lateral margins of keels somewhat convex in dorsal aspect, marginal thickenings prominent, smooth. Posterior corners of keels not produced; caudal margins of keels but little caudad of rest of tergite across body. Dorsum well arched, keels not especially wide, but continuing slope of dorsum, particularly on the anterior half of the body. Repugnatorial pores dorsal in position.

Segments 15 through 19 with keels becoming increasingly produced caudad, those of nineteenth being small, somewhat angular lobes.

Anal segment triangular in dorsal aspect, somewhat longer than broad; distally truncate. Anal valves inflated, smooth, glabrous; mesial ridges conspicuous. Preanal scale semicircular, terminal lobe sharp, lateral tubercules small.

Bases of last pair of legs almost in contact. Sternites between other legs wide, those posterior to seventh pair of legs smooth and glabrous, not produced into lobes or spines. Trochanti and femora bearing large and sharp ventral spines. Distal tarsal joint equal in length to basal two, much shorter than femur. Legs bearing slender curved terminal claws.

Coxae of second legs of males with the usual cylindrical distally flattened seminal processes.

Gonopods large, protruding from large oval aperture; at rest retracted snugly against sternites and lying against one another, usually with the blades interlocked. Lateral process unusual for the genus, strongly produced upward suggesting the development found in the genus *Deltotaria;* basal spine represented by a slight acumen at the terminal end of the process; mesial process low, rounded, rather large, the cephalic margin very setiferous. Blade of telopodite highly arched, slightly compressed dorsoventrally toward the end; distal portion not bent either laterally or mesially.

[1] Received July 28, 1948.

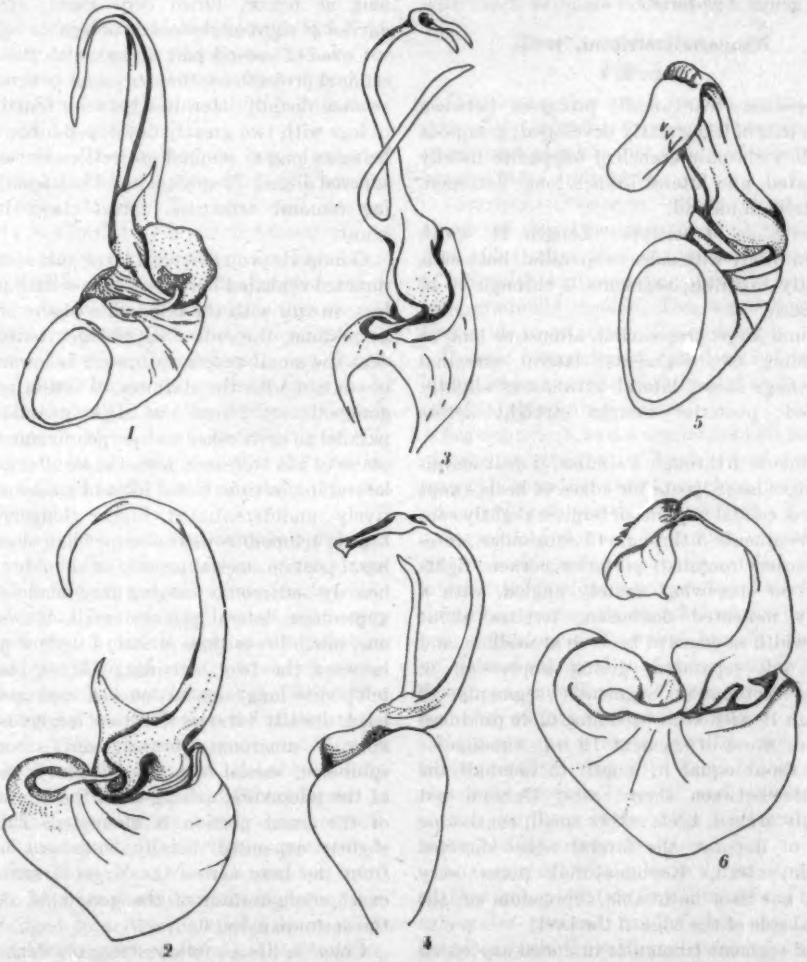
Color in life not known, appearing to have been blackish with most if not all of the dorsal surface of keels yellow or red.

Description of female allotype.—Agreeing in most respects with the male. Differs as follows: Body more arched and compact; keels of segment 19 more rounded; femoral spines longer. Length 35, width 7.6 mm.

Type locality.—Asheville, Ashe County, N.C.

Type specimens.—Male holotype and female allotype, and a paratype of each sex in the U. S. National Museum collection, no. 1833. These specimens were collected in August 1896, presumably by Dr. L. M. Underwood, of Syracuse University, although no collector is indicated on the label. Underwood collected many specimens in the Southeast during the summer of 1896.

Remarks.—The discovery of this strikingly disjunct form of *Apheloria* is of considerable importance. In addition to providing a link between the hitherto widely separated *coriacea*



FIGS. 1–6.—1, Cephalic view of left gonopod of male type, *Apheloria intermedia*, from Asheville, N. C.; 2, mesial view of same; 3, cephalic view of left gonopod of male paratype, *Nannaria morrisoni*, from Page County, Va.; 4, mesial view of same; 5, cephalic view of left gonopod of male type, *Tucoria viridicolens*, from Greensburg, Ky.; 6, mesial view of same. Pubescence has been removed from all structures figured.

and *trimaculata* sections of the genus (hence the specific name), *A. intermedia* seems to represent an ancestral stock from which the genera *Apheloria* and *Deltotaria* have been derived. It furthermore inhabits an area where one would expect just such a form to be found —western North Carolina, from whence many species of both genera have been described.

Detailed information on the relationships and phylogeny of this species is reserved for inclusion in a future publication treating the entire genus *Apheloria*.

Nannaria morrisoni, n. sp.

Figs. 3, 4

Diagnosis.—Size small; processes between fourth pair of legs greatly developed; gonopods of male with main branch of telopodite distally bifurcated, and lateral branch long, flattened, and directed mesiad.

Description of holotype.—Length 21, width 4.1 mm. Body with sides subparallel, both ends abruptly tapering; segments 3 through 16 of full width.

Collum large, trapezoidal, almost as long as succeeding two segments; lateral marginal thickenings large; lateral extremities slightly rounded; posterior margin straight across body.

Segments 2 through 4 similar, dorsal marginal ridges large, posterior edges of keels swept forward, caudal margins of tergites slightly concave. Segments 5 through 15 subsimilar, anterior corners rounded, posterior corners right-angled or somewhat acutely angled, with a weakly indicated dentation; tergites about same width at edges of keels as at midline, and keels well separated, giving impression of evenly rectangular segments; segments 16 through 19 with keels becoming more produced caudad, those of segment 19 into subangular lobes about equal in length to one-half the distance between their bases. Dorsum not strongly arched, keels rather small, continuing slope of dorsum, the lateral edges directed cephaloventrad. Repugnatorial pores very small, not in a noticeable depression, on the ventral side of the edge of the keel.

Anal segment triangular in dorsal aspect, its sides concave, the usual subterminal lateral tubercules prominent, the tip more truncate than usual, directed ventrad. Anal valves subplane, finely wrinkled, the usual setiferous tubercules not observed, mesial ridges very large. Preanal scale large, subtriangular, the median terminal lobe largest and well set off.

Bases of last pair of legs well separated. Legs of segments 8 through 18 subsimilar, sternites broad, glabrous, produced into conspicous sharp lobes at bases of legs; coxae and trochanti unarmed, femoral spines large, becoming more elongated caudad. Those of last several pairs of legs as long as femora; tarsal joints with terminal as long as basal two, almost as long as femur, tarsal claw short, strongly curved at right angle to axis of legs.

Coxae of second pair of legs with the usual seminal projections, these unusual in becoming swollen distally; sternites between fourth pair of legs with two greatly developed lobes, these being as long as seminal projections but evenly tapered distad. Pregenital limbs hairy and lacking femoral armature, tarsal claws heavy, blunt.

Gonopods project from a large oval aperture, directed cephalad between bases of fifth pair of legs; *in situ* with the telopodite blades crossed at midline, the entire appendages twisted so that the small accessory branch is lowermost, in contact with the sternites. When in use the gonopods are forced out slightly and stand parallel to each other and perpendicular to the plane of the sternites, with the smaller branch lateral in position. Coxal joint of gonopod relatively undifferentiated, higher (longer) than broad; telopodite with a somewhat elongated basal portion, mesial process or shoulder large, heavily setiferous, merging into blade of the appendage; lateral process small, inconspicuous, much lower than mesial; a narrow groove between the two, extending distad; blade of telopodite long, slender, curved cephalad over base, distally bifurcated into a larger, lateral, apically mucronate branch and a smaller, spiniform, mesial one. A secondary division of the telopodite, arising from the lateral side of the basal portion is elongated, flattened slightly expanded distally, and bent mesiad from the base across the larger branch. For exact configuration of the gonopods, consult the accompanying figure.

Color in life as follows: tergites dark olive, suffused with black, a suggestion of a median dark line on the posterior part of the body; anterior and posterior corners of keels, lateral ends of collum, and distal half of anal segment

bright pink; top of head light brown to about level of antennal sockets, front of head, including sockets and first antennal segment very dilute brown; antennae mostly olive with last article dark gray in striking contrast. Underparts entirely whitish gray.

Type locality.—Saddle Hollow, about 3 miles west of Crozet, Albemarle County, Va., elevation about 2,000 feet, on the east side of the Blue Ridge. Dominant vegetation *Liriodendron tulipifera*, *Quercus* spp., and *Cercis canadensis*.

Type specimens.—Male holotype, U.S.N.M. no. 1834, collected on March 28, 1948, by the writer; two male paratypes collected in April 1936 by Drs. Irving Fox and J. P. E. Morrison, U.S.N.M. no. 1836.

Remarks.—The paratypes were collected along Skyline Drive, 4 miles north of Thornton Gap, Page County, Va., and still another locality is afforded by a female tentatively assigned to this form, collected on the Blue Ridge about 5 miles southeast of Charlestown, Jefferson County, W. Va. The range is thus seen to be restricted to the Blue Ridge Physiographic Province between the Potomac and James Rivers, but of course the species may be found elsewhere as well. The Blue Ridge in Virginia is occupied by several distinct, probably endemic, forms of animals, so that the addition of this milliped to the list is interesting but not surprising.

Nannaria morrisoni is so manifestly different from most of the other members of the genus, such as *media*, *minor*, *conservata*, *fowleri*, and *terricola*, that its inclusion in that genus may be questioned. I place it here for the following reasons: except for the greatly produced sternal processes *morrisoni* can be separated from other forms only by the small size and nature of the gonopods. These processes are present in other species as small lobes and probably will be found to vary in size in the different forms. As regards the gonopods, while they seem very disjunct, I am describing elsewhere a species from Mountain Lake, Va., which is perhaps intermediate between *morrisoni* and the other species. Judged from the material I have examined, and from species figured in the literature, *Nannaria* can be divided into several groups on the basis of the gonopods—one based on *media* and its relatives, one on *scutellaria*, and one to include *morrisoni* and the related species mentioned above. Recognition of those groups as genera may become convenient when numerous species have been described in *Nannaria*. A thorough treatment of the genus is much needed, and in fact is contemplated, but must be preceded by extensive field work.

This species is named in honor of Dr. Joseph P. E. Morrison, of the U. S. National Museum, whose diligence and interest in securing myriapods incidentally to collection of land snails have enriched the Museum collection with much valuable material.

Tucoria viridicolens, n. sp

Figs. 5, 6

Diagnosis.—Size small for the genus; gonopods of the *splendida* type, apical process small, upper part of telopodite distad of constriction bearing three sharp teeth.

Description of holotype.—Body robust, length about 40 mm (specimen broken), width 9.3 mm; sides subparallel, segments 4 through 14 of full width; body tapering abruptly cephalad, very gradually caudad. Tergites well arched, keels wide, continuing slope of dorsum.

Collum crescentic in dorsal aspect, caudolateral edges tapering slightly cephalad; lateral marginal thickenings absent.

Segments 2, 3, and 4 similar, caudal margins of tergites straight, of keels swept forward, smoothly rounded; dorsal marginal thickenings present only on fourth, very obscure.

Segments 5 through 14 similar, caudal margins of keels produced slightly caudad, caudolateral corners of keels not produced into lobes; sides of keels smooth, rounded, somewhat convex; cephalolateral corners broadly rounded off. Dorsal marginal thickenings rather poorly developed, smooth; upper surface of keel finely granular, of dorsum slightly wrinkled.

Segments posterior to twelfth agree with those preceding, but with keels becoming increasingly produced caudad, and segments becoming narrower; keels of the nineteenth form short, bluntly triangular lobes.

Anal segment triangular in dorsal aspect, tip slightly truncated, two tiny subterminal lateral tubercules present. Anal valves slightly inflated, smooth, the setiferous tubercules almost obsolete; mesial ridges very prominent. Preanal scale broadly triangular.

Bases of last pair of legs separated. All sternites smooth, glabrous, very weakly pro-

duced into lobes at bases of legs, those posterior to gonopods broad, those between third, fourth, and fifth pairs of legs with conspicuous, low, pointed lobes. Coxae small, unarmed; trochanti weakly armed; femora with well developed spines. Terminal tarsal joint shorter than proximal two, but slightly longer than the unusually short femur.

Gonopods large, conspicious, projecting cephalad and in contact mesially. Mesial process large, very setiferous, area immediately posterior on the mesial side trilobed; lateral process very small, not produced apically; blade of telopodite flat, curved forward over base, strongly constricted about one-third its length from distal end; terminal portion bent laterad, very flattened, a small apical projection, outer surface with three conspicuous sharp teeth in an oblique row. Configuration of gonopods as shown in the accompanying drawings.

Second pair of legs with the usual cylindrical distally truncate seminal lobes. Pregenital limbs hairy, without spines on the femora; tarsal claws short, heavy, blunt.

Color faded from long preservation, but appears to have been black or very dark brown in life with caudolateral halves of the keels orange or yellow.

Type locality.—Trace Creek, Greensburg, Green County, Ky.

Type specimen.—Male holotype, U.S.N.M. no. 1835, collected by L. Garman on July 15 (no year given).

Remarks.—This species is the smallest member of the genus to be described so far. Its relationships seem to be clearly with *T. kentuckiana* and *T. splendida* rather than with *T. dynama*.

Following is a key to the known species of *Tucoria*, based on males. Females of all of the species are not known, and the genitalia of the others not figured.

KEY TO SPECIES OF TUCORIA

1. Lateral process of male gonopod small, inconspicuous, not produced upward nto any sort of spine or projection 2
   Lateral process of male gonopod larger, produced upward into a noticeable, occasionally sharp, projection 3
2. Apical process on telopodite of gonopod small, simple; distal portion of telopodite with three denticles on outer side . . . . . *viridicolens*, n. sp.
   Apical process larger, curved, slightly crenulate; distal portion of telopodite without denticles . . . . . *kentuckiana* (Causey)
3. Lateral process of gonopod produced into a broadly triangular spine; distal portion gently curved; dorsum black, trimaculate with yellow . . . . . *splendida* (Causey)
   Lateral process of gonopod produced into an upright slender peg, distally slightly acuminate; distal portion of telopodite strongly recurved toward base, much expanded; dorsum with yellow cross bands . . . . . *dynama* Chamberlin

ZOOLOGY.—*More about Mexican urocoptid mollusks.*[1] PAUL BARTSCH, U. S. National Museum.

The tireless efforts of Miss Marie E. Bourgeois in personally collecting mollusks and interesting her friends in this group have brought to light two species of urocops not heretofore known to science. These are here diagnosed. A detailed description of *Oligostylus hegeweschi* is also made possible from topotypes that she collected.

Oligostylus hegewischi Bartsch

In my paper *Notes on some Mexican urocoptid mollusks, with the description of new species* in this JOURNAL.[2] I renamed *Bulimus truncatus* Pfeiffer, 1841 (preoccupied by *Bulimus truncatus* Bruguière, 1792), calling it *Oligostylus? hegewischi*. No material from the type locality being available, I placed a query after the generic designation. I closed my remarks under that species with the statement: "It is to be hoped that Miss Bourgeois will rediscover it at Angangueo." Miss Bourgeois took this to heart and paid a visit to Angangueo, Michoacán, and secured a fine series of specimens of this species and donated a splendid lot (No. 488018) to the U. S. National Museum which makes it possible for me to confirm the statement made in my paper and to remove the question mark after the generic name, for these topotypes prove to be a typical *Oligostylus*.

[1] Received July 8, 1948.
[2] Journ. Washington Acad. Sci. 37: 284–288, 1947.

Miss Bourgeois tells us that the specimens were found "well buried in the leaf mold, or humus (perhaps they were depositing eggs) under dead agave leaves, always well buried in the earth, near the roots, or center of almost every agave (or maguey plant)." These plants, she says, "strange to say, were far up on the mountainside of Cerro Guadalupe, just north of town." This mountain contains no limestone, and the superintendent of the mines told her that there was no limestone within 40 kilometers of Angangueo, which is 2,800 meters above sea level.

FIG. 1.—*Coelocentrum anconai*, n. sp. FIG. 2.—*Liocentrum wilmoti*, n. sp.

To my translation of Pfeiffer's description I may now add:

The eggs are white, symmetrically oval, finely, microscopically granulose, measuring in length 4.2 mm, diameter 2.3 mm.

The first 5 whorls of the shell form a cylindrical apex; beyond this the shell gains very gradually. The apex is blunt. The first turn and a half are smooth; the whorls thereafter become axially ribbed and are at first weakly, then more strongly, retractively curved. The ribs are sinuous and average about half the width of the spaces that separate them. They are strongest in the middle turns and weaken toward the end, where the surface shows irregular, small malleations. Fifty of them are present on the last turn of the young specimens here figured. Suture well impressed. Periphery of the last whorl weakly angulated. Base short, with a small umbilical chink, well rounded, and marked by the continuations of the axial ribs. Aperture subcircular. Peristome white, thickened at the outer margin, adnate to the preceding whorl. The columella is slender. The shell on the later turns is chestnut brown, gradually paling to horn color near the summit of the whorls, contrasting markedly with the yellowish-white peristome.

The young specimen figured has 10.1 whorls and measures: Length 10.3 mm, diameter 4.1 mm. The adult shell figured has 7.5 whorls remaining and measures: Length 29.2 mm, diameter 10 mm.

This species resembles *Oligostylus mariae* Bartsch but is readily distinguished from it by its much weaker ribs and by the malleation of the later turns.

Coelocentrum anconai, n. sp.

Fig. 1

Shell large, elongate-turreted. Our bleached specimens are yellowish white with the peristome buff. Early whorls decollated. The 9.5 whorls remaining in the type are slightly rounded and crossed by numerous closely spaced, retractively curved axial ribs, which are best developed near the periphery and summit of the whorls, becoming decidedly reduced on the middle of the turns. More than 200 of these are present upon the penultimate turn. Suture weakly impressed. Periphery obscurely angulated. Base well rounded, with an umbilical chink, marked by the feeble continuation of the axial ribs. Aperture subquadrate. Peristome slightly thickened and reflected at the edge, free for about 1 mm from the preceding whorl. There is a slight carina present on the outside at the posterior angle. A fold is apparent on the columella deep within the aperture. Columella narrow with a decided twist, bearing distantly spaced, sigmoid, and sublamellar folds. The type, U. S. N. M. no. 589052, has 9.5 whorls remaining and measures: Length 61 mm; diameter 20 mm. It was collected in the

woods of Ocote, at Ocozocoantla, Chiapas, and donated to the Museum by Prof. I. Ancona, whose name I am pleased to attach to the species.

A second specimen somewhat less perfect is in Professor Ancona's collection.

The large size and slender columella will readily distinguish this from the other known species of *Coelocentrum*.

In the narrowness of the columella it resembles *Coelocentrum pfeifferi* Dall from the same general region. That species, however, is very much smaller. The type measures: Length 38 mm, diameter 16 mm. The largest specimen, a topotype, having 8.2 whorls, measures: Length 44.8 mm, diameter 16 mm.

Liocentrum wilmoti, n. sp

Fig. 2

Shell of medium size, white. The truncated specimen almost cylindric. The remaining whorls are slightly rounded and marked by numerous slightly curved, retractively slanting axial ribs separated by spaces about as wide as the ribs, of which 140 are present upon the penultimate whorl. These riblets pass undiminished from the summit to the periphery. Suture slightly impressed. Periphery with a weak keel. Base short, well rounded, with an umbilical chink, marked by the continuation of the axial ribs. Aperture obliquely subcircular with a columellar fold deep within; peristome adnate to the preceding whorl at the parietal wall. Columella slender, twisted, smooth. The type U.S.N.M. no. 589051, was collected by George Wilmot in Oaxaca, on a mountainside near the auto highway, between the cities of Oaxaca and Tehuantepec. It has 8.1 whorls remaining and measures: Length 27.3 mm; diameter 10.4 mm.

In outline it somewhat resembles von Martens' *Coelocentrum championi* from the Cerro Zunil, Guatemala, differing from this, however, in the aperture, which is solute in von Martens' species, the size of columella, and other details.

ACADEMY'S ANNIVERSARY "RED BOOK" DISTRIBUTED

The thirty-third edition of the Academy's Directory, or "Red Book," commemorating the fiftieth anniversary of the founding of the Academy and containing pictures of 499 of its members, was published in July and distributed to the membership. This is the first Directory so illustrated to appear. Carrying as it does halftone reproductions of portraits of many of the leading scientists and engineers of the Washington area, it forms a pictorial and historical record that should increase in interest and value over the years.

As usual, The Directory carries a complete list of Academy members and members of affiliated societies, with addresses. Also given are names of the officers, text of the bylaws and constitutions, and brief historical résumés of the organization of each of the 19 societies affiliated with the Academy. The book aggregates 300 pages.

Less than 90 copies remain available for sale. They are priced at $1 per copy to individuals. Orders and remittances should be addressed to HOWARD S. RAPPLEYE, Treasurer of the Washington Academy of Sciences, U. S. Coast and Geodetic Survey, Washington 25, D. C.